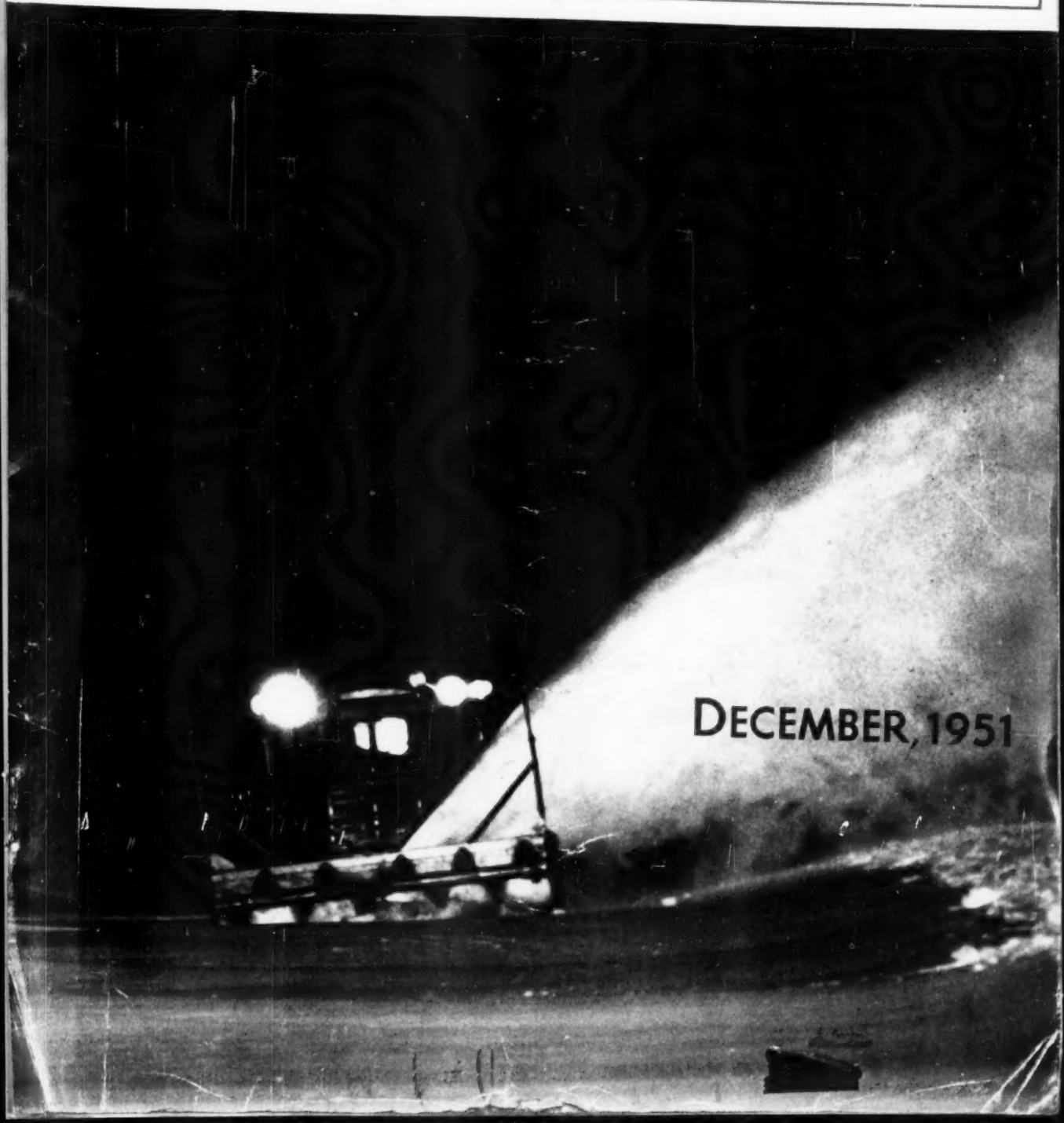
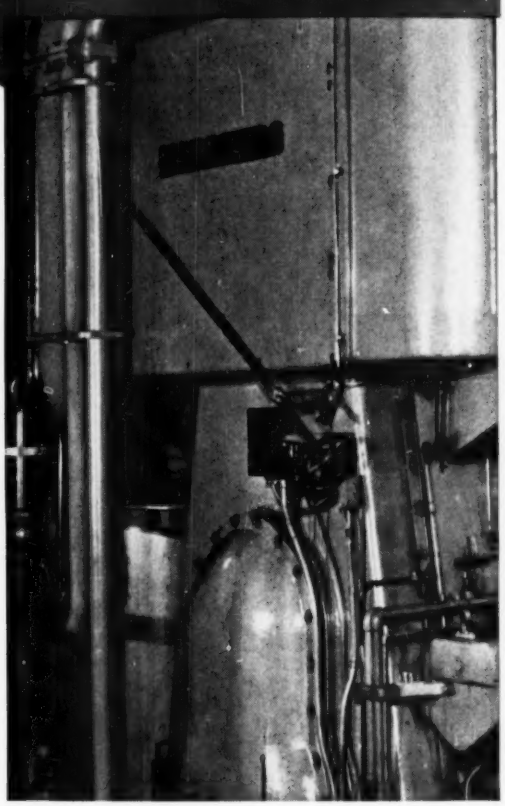
Diesel Power
& Diesel Transportation



DECEMBER, 1951

65,000 HOURS — WEAR

City of Greenville Diesel turns in impressive 5-year record lubricated with TEXACO URSA OIL



THIS Nordberg 2,400 h.p. Diesel engine was installed in the municipal power plant at Greenville, Texas, in 1946 – and has been lubricated continuously with *Texaco Ursa Oils* in both crankcase and cylinders. G. C. Pullen, Master Mechanic, reports on its condition at the latest inspection . . .

"We took the engine down at about 65,000 hours operation. When we miked the cylinders, the greatest amount of wear found was only .018" – and that at only two points. Most of the measurements ranged from .008" to .015" – an average of only .0002" wear per 1,000 hours of operation. Furthermore, in No. 1 cylinder the original rings, delivered on the engine in 1946, were found to be in such good condition they were placed right back in service."

★ ★ ★

Count on *Texaco Ursa Oil* to give *your* Diesels the

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. METROPOLITAN OPERA broadcasts every Saturday afternoon.

TEXACO

TEXACO

DIESEL POWER and DIESEL TRANSPORTATION for December, 1951, Vol. XXIX, No. 12. It is published monthly by Diesel Publications, Inc., Orange, Conn. Executive and Editorial offices at 192 Lexington Ave., New York 16, N. Y. Subscription rates: United States, $3.00 per year, single copies 35¢; Canada $4.00; Foreign $5.00 per year. Entered as second class matter April 29, 1949 at the Post Office, Orange, Connecticut under Act of March 3, 1879.

OPERATION NEGLIGIBLE

clean operation that means less wear, less maintenance cost, less fuel consumption. *Texaco Ursa Oil* is highly resistant to oxidation . . . keeps rings free, valve action smooth and snappy. Assures longer life for bearings and all moving parts. In two-cycle engines, ports stay clear.

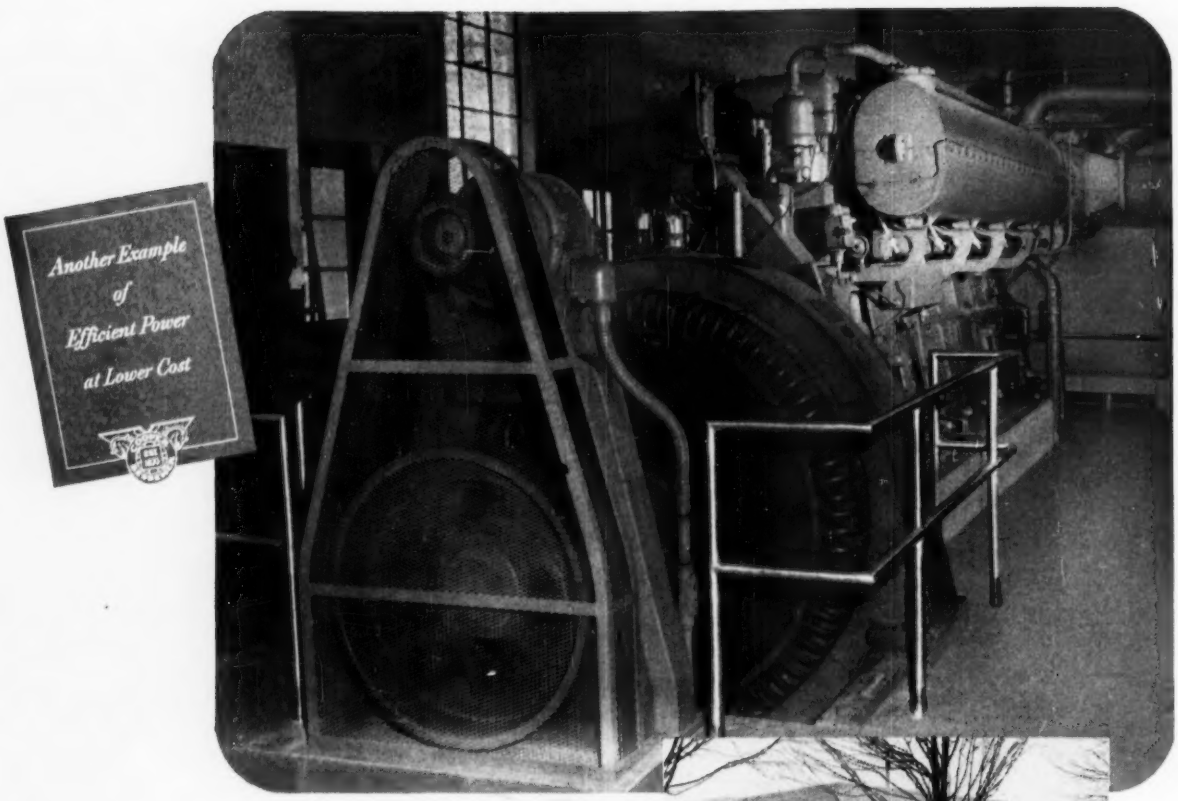
There is a complete line of Texaco Diesel lubricating oils approved by leading Diesel engine builders and preferred by operators everywhere. In fact –

For over 15 years, more stationary Diesel h.p. in the U. S. has been lubricated with Texaco than with any other brand.

Call in a Texaco Lubrication Engineer for full details. Just contact the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

URSA OILS **FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES**



Preferred at PORTLAND

. . . Cooper-Bessemer fuel and space savings!

POWER facilities at the Village of Portland, Michigan, had to be expanded. A Cooper-Bessemer diesel was the carefully considered choice — as is so often the case in municipal, R.E.A. and other stationary services when *all* the facts are weighed.

Portland's new Cooper-Bessemer is shown above — a modern, supercharged JS-8, rated 1,158 bhp at 450 rpm driving an 820 K.W. generator

First, for an engine that has proved itself equal to year after year of continuous, trouble-free service, it offers unmatched *compactness* — a fact that saved Portland plenty in reduced installation, foundation and piping costs.

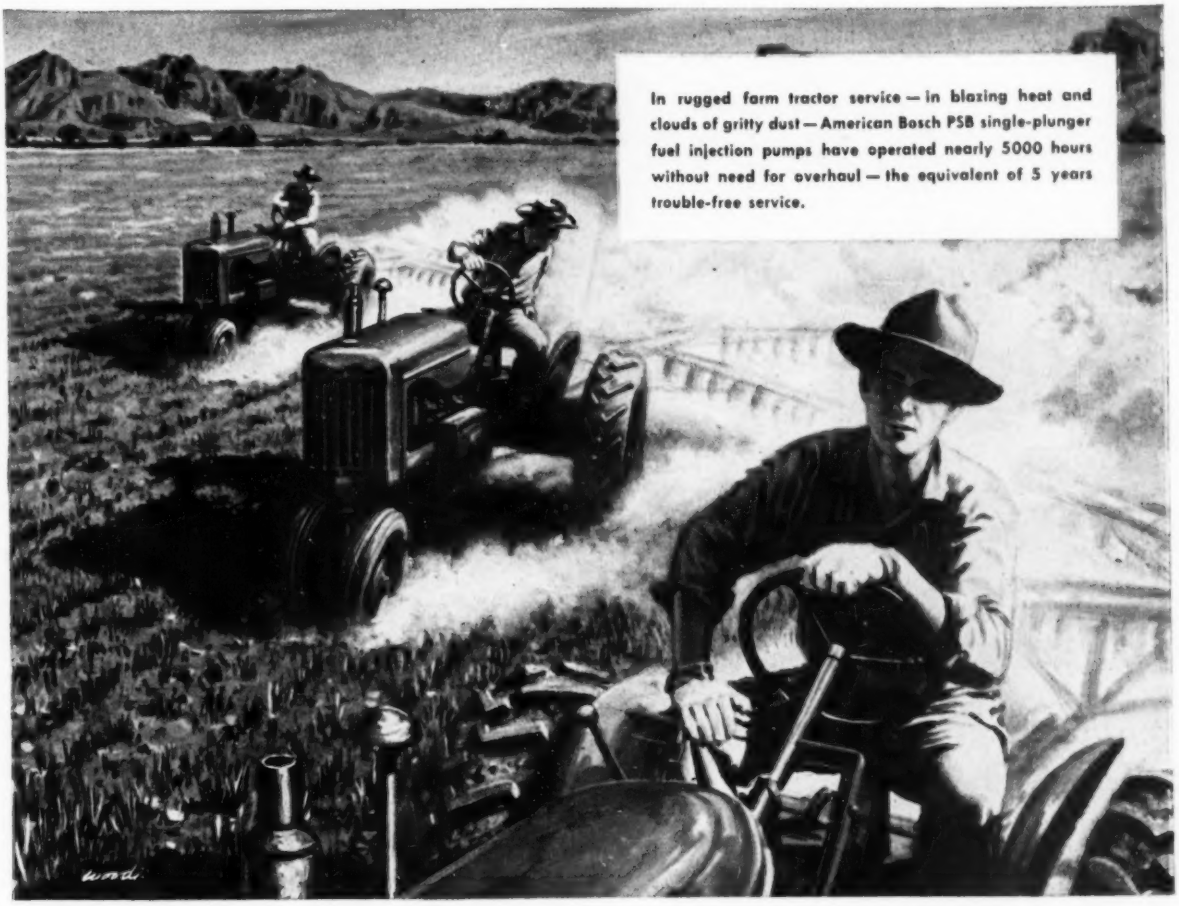
Second, the supercharged JS is noted for exceptional efficiency and unusually low fuel consumption at all loads.

If your plans call for diesel, gas-diesel or gas engine power, 60 to 3700 hp, be sure to get information on the Cooper-Bessemer developments that can save you money all along the line.

The
Cooper-Bessemer
Corporation

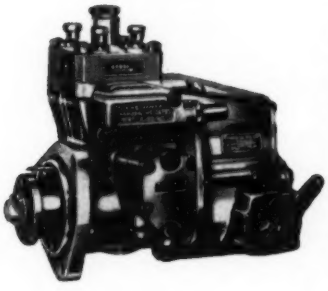
MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. Calmes Engineering Co., New Orleans, La.



In rugged farm tractor service — in blazing heat and clouds of gritty dust — American Bosch PSB single-plunger fuel injection pumps have operated nearly 5000 hours without need for overhaul — the equivalent of 5 years trouble-free service.

PROVED ON THE TOUGHEST JOBS . . .
AMERICAN BOSCH *PSB fuel injection pump*



Tried and proved in the severest service, the American Bosch PSB single-plunger multi-cylinder fuel injection pump is expanding the use of economical Diesel power in fields where automotive-type Diesel engines are particularly adaptable.

Considerably smaller in size and weight than comparable multi-plunger types, the PSB pump uses only a single plunger to serve as many as six engine cylinders — can be more easily serviced in the field — reduces substantially the cost of injection equipment for small Diesel engines — has rolled up remarkable records of performance in severe service.

The engineering and production techniques that made possible the successful development of the single-plunger injection pump result from over 40 years experience of American Bosch in the design and manufacture of precision products — coupled with a strong research program that leads constantly to new and better contributions to the automotive, aviation and Diesel industries. American Bosch Corporation, Springfield 7, Mass.

AMERICAN BOSCH

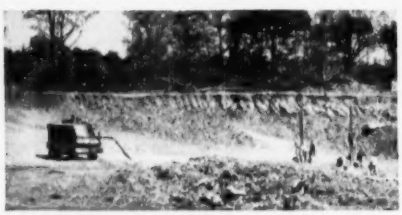
American Bosch

MAGNETOS • GENERATORS • VOLTAGE REGULATORS • IGNITION COILS • ELECTRIC WINDSHIELD WIPERS • DIESEL FUEL INJECTION EQUIPMENT

AMERICAN BOSCH CORPORATION • SPRINGFIELD 7, MASS.

GM DIESEL powers world's most compact 600 cfm Compressor

CONSTRUCTION—"Starts like a charm, even on the coldest morning. No time wasted in getting up to pressure. Runs a heavy pile driver with ease. We can set it out of the way with a crane and move it back to the roadway for towing in no time."



QUARRYING AND MINING—"We couldn't imagine 600 feet coming from such a slick little compressor until we saw the increased drill footage, and the ease with which it took over two FM-2 wagon drills. Good fuel economy, too."

HIGHWAY BUILDING—"Plenty of reserve—full capacity at 6,730 feet altitude. We're operating eight 55-lb. blower drills putting in 20-ft. holes on cliffsides. So easy to maneuver and work with that it's a natural for tough jobs like this."

WINNING acclaim as the world's smallest, lightest, big-capacity portable compressor, the new Ingersoll-Rand Gyro-Flow 600 is powered by a 6-cylinder General Motors Series 71 Diesel engine.

This compact, high-powered portable delivers a full 600 cubic feet of air per minute at a steady 100-lb. pressure, yet it weighs only 9,500 pounds. It is 20 to 40% lighter—and as much as 20% smaller—than other portables of comparable capacity.

Being 2-cycle, GM Diesel engines pack more power in less space. They start quickly on their own fuel, run smoothly and enable equipment to maintain rated performance at high altitudes. They're designed for ease of maintenance—no high-pressure fuel tubing—unit injectors that can be changed in a matter of minutes. And, when needed, low-cost "Factory-Engineered" parts are readily obtainable.

These modern 2-cycle Diesels are bringing new economy and efficiency to more than 500 different kinds of power equipment built by 120 manufacturers. Ask your GM Diesel distributor or write us for full details.

ANSWER THE CALL CIVIL DEFENSE

DETROIT DIESEL ENGINE DIVISION

SINGLE ENGINES... Up to 275 H.P. **DETROIT 28, MICHIGAN** MULTIPLE UNITS... Up to 800 H.P.

GENERAL MOTORS

GM GENERAL MOTORS DIESEL POWER

DIESEL BRAWN WITHOUT THE BULK

Newest in Diesel Design has *Latest* in Automatic Protection

...by Alnor

Recently developed radial Diesel has the industry talking about the newest in engine design—the latest in automatic protection.

From the first, these new engines have been protected by Alnor Pyrotacs that continually monitor exhaust temperatures . . . automatically check all cylinders, anticipate trouble from overloading or lubrication breakdown.

You too will find many applications for the Alnor Pyrotac and motor driven switch that bring you these exclusive features:

- Constant monitoring of up to 20 temperature points.
- Automatic shutdown when maximum safe temperature is reached.
- Switch pointer stops at position of excessive temperature.
- Both faces easily read from 20 feet—for minimum supervision.
- All circuits non-electronic—need no tuning.
- Switch cycle can be interrupted for close reading of each temperature.

Such constant, automatic protection increases efficiency and operating economy on all engines—reduces maintenance time and expense to a minimum.

Ask your Alnor representative for assistance in solving your pyrometer problems today! He can help you select the right pyrometer and thermocouples for maximum protection of your engine installation. Illinois Testing Laboratories, Inc., Rm. 507, 420 N. La Salle Street, Chicago 10, Ill.

Alnor **PRECISION INSTRUMENTS FOR EVERY INDUSTRY**

ILLINOIS TESTING LABORATORIES, INC.

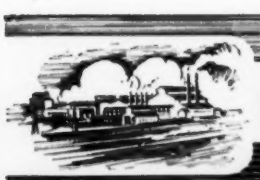
Room 507, 420 N. La Salle Street • Chicago 10, Illinois

"When they saw the star, they rejoiced---"

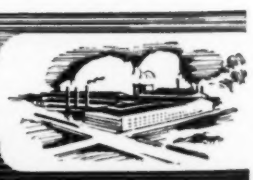
Matthew 2-10

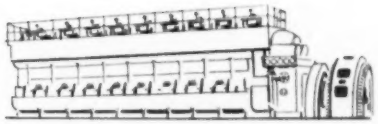
IS not this, then, a season for rejoicing . . . a season for reviewing and re-appraising the priceless values we have enjoyed in this America? Among others, the eminent right of free enterprise . . . the right to work at or leave any job anywhere at any time. Shall we not agree that so fortunate a people must guard its heritage jealously? This land of ours challenges men against failure in any venture . . . its reward to men who work is a cretain security . . . a cretain freedom to think and to act together and as individuals for the greatest good to all the people of the world. Shall we look with sincere appreciation upon the gift we have so lately received from the valient? . . . Shall we pause this Holiday Season to render to God our gratitude and to America our undivided loyalty so that there may be. . .

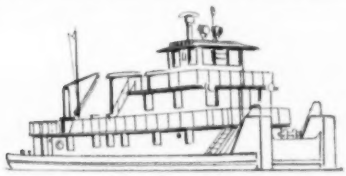
Peace on Earth to Men of Good Will.



ERIE FORGE COMPANY, ERIE, PA.

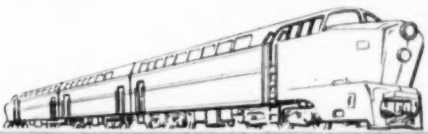






Gulf Dieselmotive Oil

cuts maintenance costs for industrial, workboat and railroad Diesels



Here's why:

- Effective detergent action—Keeps rings clean
- 100% solvent-refined oil
- Does not form hard metal-like deposits on piston crowns
- Oxidation inhibited—resists sludging
- Nonfoaming

Here is the oil that provides protection plus for industrial, workboat, and railway Diesels—Gulf Dieselmotive Oil.

Made from 100% solvent-refined oil, it does not form harmful metal-like deposits on piston crowns, especially important where the same oil is in service for a long period of time.

Gulf Dieselmotive Oil has effective detergent-dispersant action, which helps keep oil-control and compression rings clean and free, and retards sludge formation. As a result, wear and oil consumption are remarkably low.

Containing an excellent oxidation inhibitor, Gulf Dieselmotive Oil has outstanding resistance to oxidation and the formation of crankcase sludge. It's nonfoaming and noncorrosive to silver bearings.

These advantages of Gulf Dieselmotive Oil add up to cleaner engines, reduced cylinder wear, and lower maintenance costs.

For further information call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office.

Gulf Oil Corporation · Gulf Refining Company,
Gulf Building, Pittsburgh 30, Pennsylvania.

FIFTY YEARS OF SERVICE
1901 GULF 1951
PETROLEUM AND ITS PRODUCTS

P&H DIESEL ENGINES

2-CYCLE

SHOCK LOADS

EVERY 30 SECONDS

That's normal operation for power shovels—the toughest assignment known for diesel engines. It's the service P&H Diesels were designed to take. Years of superior performance, attested by hundreds of users, prove that P&H Diesels can take *any* of your toughest jobs in stride. It's one reason wise users are standardizing on P&H Diesels. There are many other reasons worth learning. For literature, write Diesel Division, Harnischfeger Corporation, Crystal Lake, Illinois.

P&H DIESEL DIVISION
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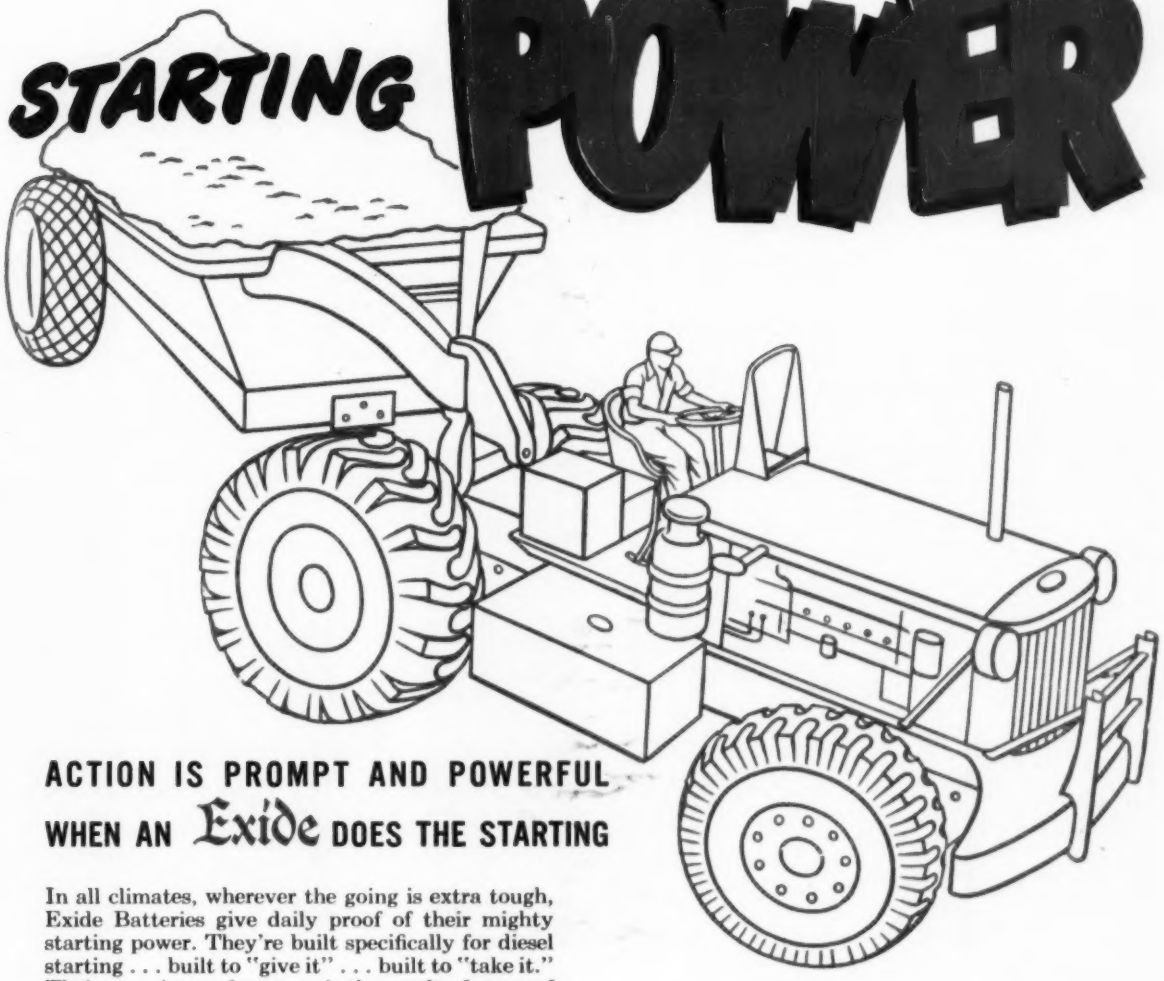
STARTING POWER



ACTION IS PROMPT AND POWERFUL WHEN AN Exide DOES THE STARTING

In all climates, wherever the going is extra tough, Exide Batteries give daily proof of their mighty starting power. They're built specifically for diesel starting . . . built to "give it" . . . built to "take it." Their superior performance is the result of years of research-engineering, plus continuous testing under all service conditions. The object: to give you a battery that's outstanding for all heavy-duty starting jobs. In Exide diesel-starting batteries you get:

QUICK BREAKAWAY and fast acceleration of engine to firing speed.

LOW DEPRECIATION due to their extra long life.

LOW COSTS of operation and maintenance.

RUGGED CONSTRUCTION for rough usage in hard service.

Use Exide Diesel Starting Batteries for all heavy-duty service—in buses, trucks, tractors, off-the-highway equipment, ships, power plants, diesel-electric locomotives.

THE ELECTRIC STORAGE BATTERY COMPANY
Philadelphia 2

Exide Batteries of Canada, Limited, Toronto

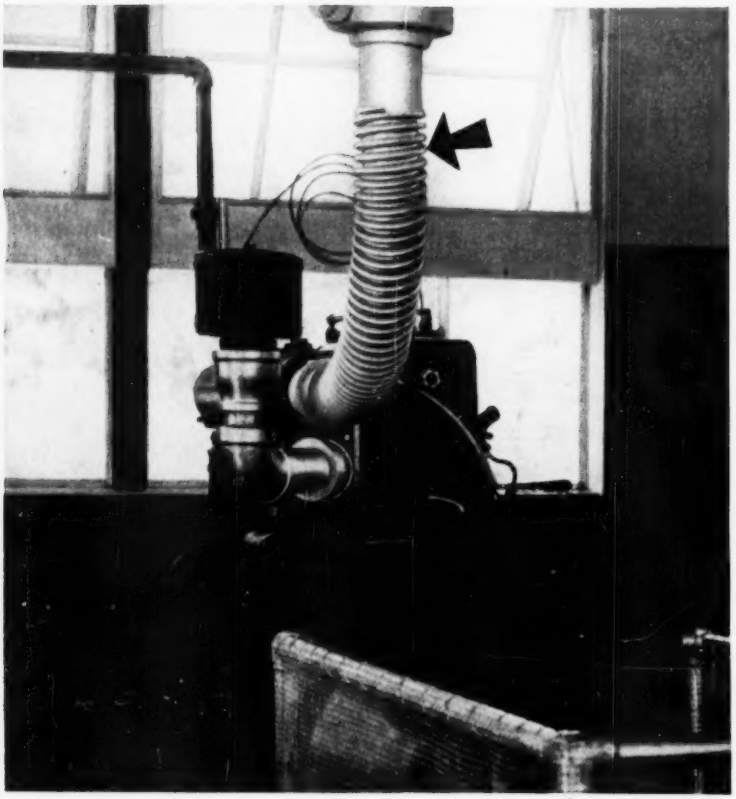
"Exide" Reg. Trade-mark U.S. Pat. Off.

WHEN IT'S AN EXIDE YOUR DIESELS START

1888...DEPENDABLE BATTERIES FOR 63 YEARS...1951

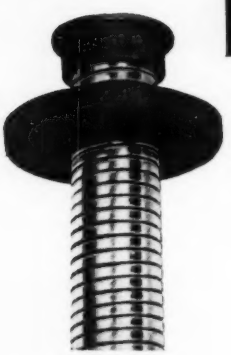
Easy-to-Install, Vibration-Proof,

American **FLEXIBLE** Metal Hose for Diesel Installations



Flexible Metal Hose on diesel exhausts and air intakes is simple to install where offset connections are involved. You just bend it to the curves required.

Flexible Metal Hose effectively absorbs line vibration and adjusts itself to thermal expansion and contraction—and thus is free from all shear and vibration stresses.



American Flexible Steel Exhaust or Air Intake Hose is available in *two* types: Corrugated Steel; and Interlocked Steel. Both are gas-tight, strong and able to withstand extreme service temperatures. For full details on both these logical products for diesel exhaust and air intake lines, just write for Bulletin EH-50, to The American Brass Company, American Metal Hose Branch, Waterbury 20, Connecticut. In Canada: The Canadian Fairbanks-Morse Company, Ltd. 61256

wherever connectors must move...

American ANACONDA

FLEXIBLE METAL HOSE AND TUBING

Other Products for Diesel Use

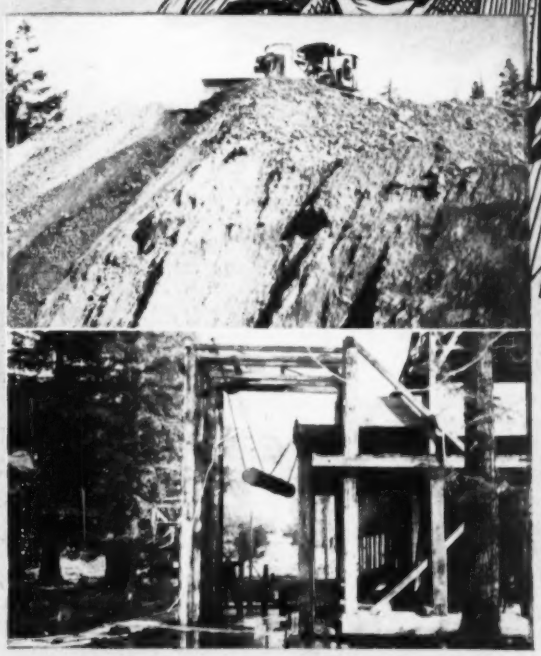
Connections for carrying OIL, AIR, WATER, EXHAUST, ETC., UNDER ROUGH MECHANICAL AND TEMPERATURE CONDITIONS. Write for literature.

"My Winslow Dealer goes out of his way to give me service!"

K. B. McGuire
Ft. Bragg, Calif.

Kelly B. McGuire and his two sons are prominent western lumbermen, with logging and sawmill operations in the rugged mountains on northern California's coast. Theirs is the vital job of helping to supply timber for defense and civilian uses, so their tractors, trucks and stationary engines need all the protection that fine lubricants and efficient filtration can give them. This makes it all the more important when Mr. McGuire says:

"I have been using Winslow Elements for over 12 years. Away back in the beginning I learned the need for adequate filtration, and through all these years Winslow Elements have given economical and dependable performance. Just as important, my local Winslow dealer has gone out of his way to give me helpful service at all times."



Lubricants needed all the protection they could get when roads were built (upper) to McGuire lumbering operations. Lower is one of McGuire's log hoists.

WINSLOW MAKES THE *RIGHT* FILTER FOR ANY ENGINE AND THE *RIGHT* ELEMENT FOR ANY FILTER. ASK FOR OUR FREE BOOKLET, "THE CASE OF THE DIRTY DRIP".

WINSLOW FILTERS

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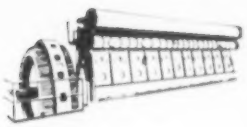
BALDWIN LIMA

ACTION"



helps HAMILTON squeeze more horsepower from fuels

One of the very few large diesels completely redesigned since the war is the new Hamilton 21-SA. As a result, it includes all those new engineering advancements that mean *more horsepower* from every drop of fuel.

Take the scavenging and combustion system, for instance. It's new . . . *and completely different.*

Exclusive rotary valves, a semi-hemispherical combustion chamber made by a cup-topped piston and recessed cylinder head, proportioned porting and an annular wall chamber, *trap 40% more air in the cylinder.* Then combine to squeeze this extra air into the fuel spray cone just as the piston reaches top dead center and as combustion is getting started.

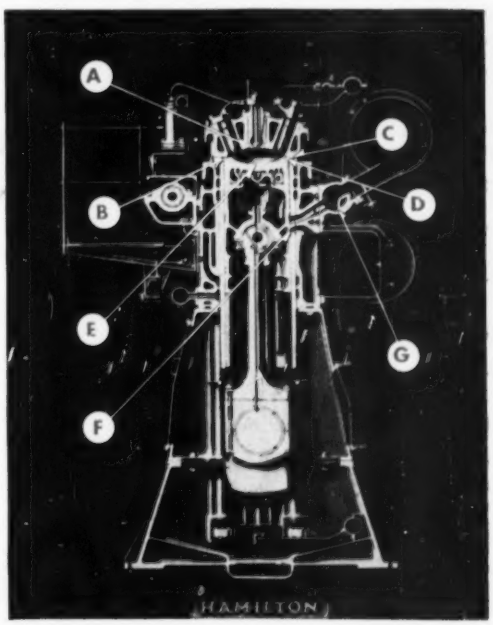
That's "Squish Action!" . . . the secret of the better efficiencies of the Hamilton 21-SA.

Which in turn explains why this Hamilton 21-SA diesel gives *more horsepower* per cylinder size and speed than any other equivalent engine. And why it can burn the heaviest fuel with a clean exhaust . . . give the same output ratings on *both* dual fuel and diesel cycles.

Yet this is just one of the unusual features of this unusual diesel. So why not get in touch with us for *complete* information. There's no obligation.

Hamilton 21-SA diesels are available for marine or stationary applications either dual fuel or straight diesel. Built 5 to 12 cylinders with output range from 2250 to 6860 hp. at 240 to 277 rpm.

A. Recessed Cylinder Head
B. Flat on Cylinder Head
C. Annular Space
D. Flat on Piston Crown
E. Cupped Piston Crown
F. Looped Scavenging System with Proportioned Porting
G. Exclusive Rotary Valve

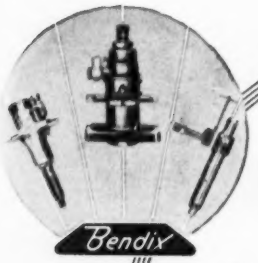


MORE POWER — LESS FUEL
CLEAR, COOLER EXHAUST

CORPORATION Hamilton, Ohio

- HAMILTON

Diesel Power and Diesel Transportation



A NATION-WIDE *Authorized* SERVICE ORGANIZATION

Bendix

FUEL INJECTION EQUIPMENT

DIRECTORY OF SERVICE STATIONS IN U. S. A.

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Los Angeles 21, Magneto Sales & Service Co., 751 Towne Ave.
Sacramento 1, Langer & Rifkin, 1116 Fifth Street
San Diego 1, Magneto Sales & Service Co., 1254 Kettner Blvd.
San Francisco 3, Furrer & Uster, Inc., 225—7th St.
San Francisco 3, H. G. Makelim Magneto Repair Co., 1583 Howard Street
Wilmington, Diesel Control Corporation, 218 North Marine Ave.

COLORADO

Denver 3, Central Supply Co., 1171 Lincoln Street

FLORIDA

Jacksonville 1, Spencer Electric Co., Inc., 40 West Beaver Street
Miami 36, Florida Diesel Service Co., 1930 North Miami Ave.

GEORGIA

Atlanta 3, Auto Electric & Magneto Co., 477 Spring Street, N. W.

ILLINOIS

Chicago 16, Illinois Auto Electric Co., 2011—37 Indiana Ave.
Rock Island, Lohse Automotive Service, Inc., 430 North Capitol Ave.

INDIANA

Indianapolis, Gulling Auto Electric Inc., 450 North Capital Ave.

IOWA

Cedar Rapids, Edwards Carburetor & Electric Co., 209 Seventh St., S. E.
Des Moines 9, Electrical Service & Sales Co., 1313 Walnut Street

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New Orleans 13, John M. Walton, Inc., 1050 Carondelet Street
Shreveport, Vaughan Tractor & Auto Parts Co., 224 Airport Drive

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Minneapolis 2, Reinhard Bros. Co., Inc., 11 South 9th Street

MISSOURI

Kansas City 8, Electrical & Magneto Service, Inc., 2538 Grand Ave.
St. Louis 23, Diesel Fuel Injection Service Co., 9331 South Broadway

NEBRASKA

Omaha 2, Carl A. Anderson, Inc., 16th and Jones Street

NEW JERSEY

Newark 2, Tire Trading Co., 239 Halsey Street

NEW YORK

Brooklyn 16, E. A. Wildermuth, Inc., 1102 Atlantic Ave.
Brooklyn 32, A & D Diesel Service, Inc., 677 Fourth Ave.
Buffalo 8, Hettrich Electric Service, 1032 Ellicott Street
Syracuse 4, F. A. Crossman, Inc., 943 Genesee Street
Troy, Ehrlich Electric Service, Inc., 200 Fourth Street

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Cleveland 14, Cleveland Ignition Co., 1301 Superior Ave., N. E.

OKLAHOMA

Tulsa 3, Magneto Ignition Co., 701 West 5th Street

OREGON

Portland 14, Automotive Products, Inc., 1700 Southeast Grand Ave.

PENNSYLVANIA

Philadelphia 32, J. W. Parkin, Jr., 2251 North Broad Street
Pittsburgh 13, Automotive Ignition Co., 6358 Penn Ave.

TENNESSEE

Memphis 4, Automotive Electric Service Co., 982 Linden Ave.

TEXAS

Dallas 1, Beard & Stone Electric Co., 3909 Live Oak St.
El Paso, Oakes Battery & Electric Co., 423 Texas Street
Houston 1, Beard & Stone Electric Co., Milam at Polk Street
Houston 11, Magneto & Diesel Injector Service, 6931 Navigation Blvd.
Odessa, Electric Service & Supply, 1601 North Grant Street

VIRGINIA

Norfolk, Diesel Injection Sales & Service, 808 Union Street
Richmond 20, Charles H. Woodward Electric Co., 709 Broad Street

WASHINGTON

Seattle 1, Seattle Injector Co., 2706—2nd Ave.
Seattle 14, Sunset Electric Co., 300 Westlake, North
Spokane 8, Sunset Electric Co., North 703 Division St.

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He'll be frank with you. If no cost improvement can be made by changing your Diesel lubrication practices, that's the opinion you'll get from a Cities Service Lubrication Engineer. And just as frankly he'll present you with evidence of any cost leaks revealed by his study of your lubrication program.

In taking action you can command the full Diesel experience of Cities Service—one of the largest, fastest-growing, most progressive oil companies, with scientifically-formulated Diesel lubricants in types and grades to meet all modern requirements. This wide range offers strong possibilities for you and the Cities Service man to improve on even "satisfactory" Diesel operation. Get his competent help now by writing to CITIES SERVICE OIL COMPANY, Room 241, 60 Wall Tower, New York City 5. Or call the Cities Service office nearest you.

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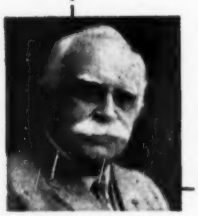
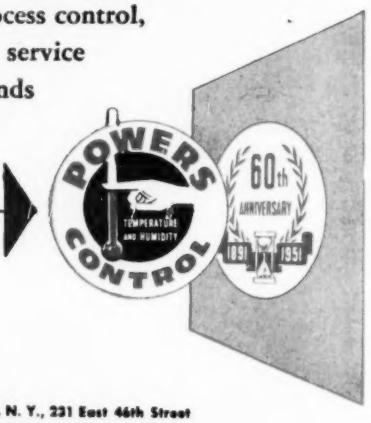


WILLIAM PENN POWERS
. . . with his invention of the first all pneumatic system of temperature control and gradual acting vapor disc thermostat made an invaluable contribution to the modern science of heating, air conditioning and industrial process control.



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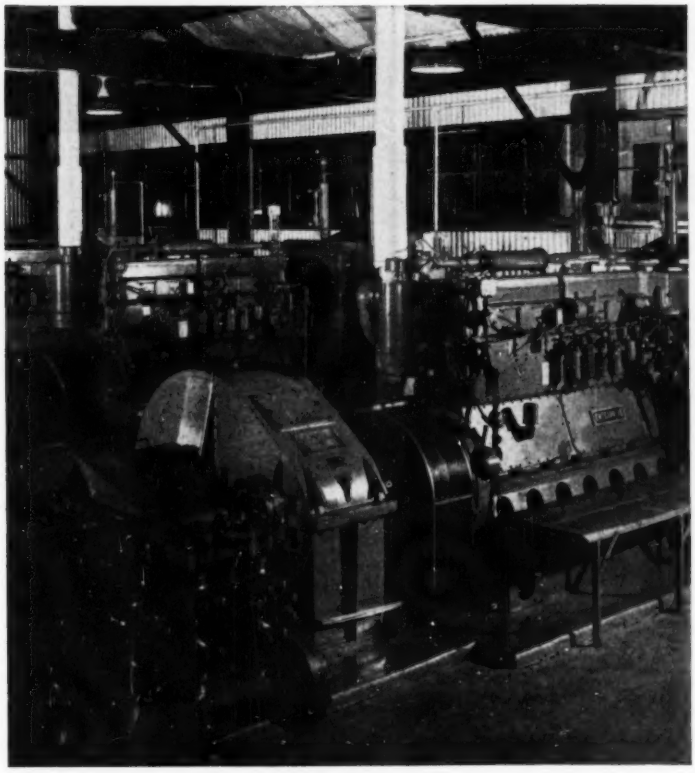
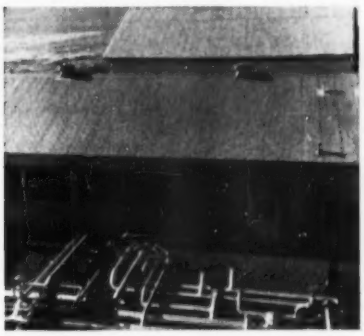
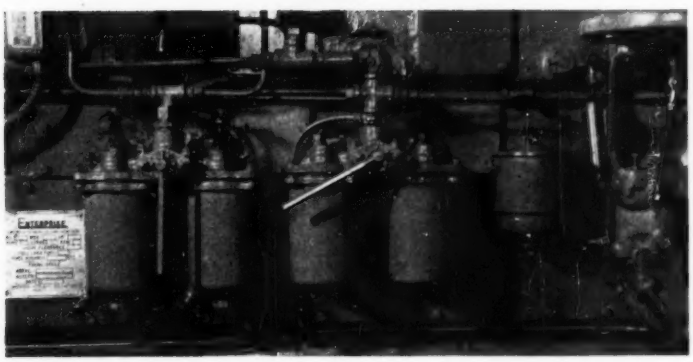
HOT Performance



Hot or cold, Purolator Oil Filters do the job they're designed for. Here at Antelope Station, Union Oil Company of California's new pumping plant, 3 Enterprise Diesel engines push upwards of 1000 barrels 16 gravity crude per hour uphill toward Avila, Cal., 60 miles west. And they do it "hot."



Engines are conventional 8 in. bore x 10 in. stroke Enterprise Diesels of medium speed (220 h.p. at 720 RPM). Fuel is taken from line, centrifuged, then passed through heater to raise temperature to 180° F.



Hot, free-flowing fuel goes through metalized Purolator strainers on fuel pump which passes it on through tandem Purolator Filters to remove further impurities. Result: smoke-free exhaust—efficient performance at 2500-hour mark.

Antelope Installation is another case illustrating the reliance manufacturers and operators place on the Purolator equipment.

A Purolator Micronic* Oil Filter, for example, traps abrasive particles as small as microns (.000039"); *traps more dirt faster*—because its accordion-pleated refill provides filtering area up to 10 times greater than old-style filters. And it won't warp, distort, or disintegrate.

For lube oil, a Purolator* assures less wear on hard-working bearings and other vital parts.

For fuel, it provides the complete filtration, so essential for close tolerance injector orifices.

Whatever your filtering problem, let our engineering staff show you how to solve it!

* Reg. U. S. Pat. Off.

Protect your Power with...

PUROLATOR PRODUCTS, INC.
Rahway, New Jersey, and Toronto, Ontario, Canada
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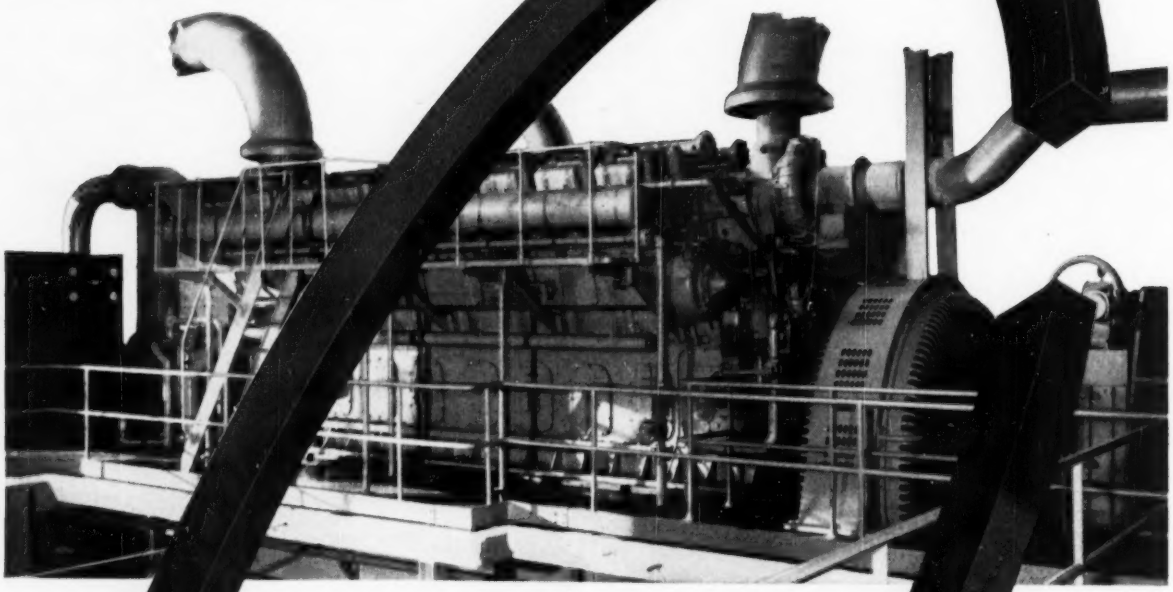
PUROLATOR
MICRONIC OIL FILTER
"FIRST IN THE FIELD OF FILTERING"

KOPPERS Porous Chrome Rings keep maintenance costs to a minimum in diesel power plant



Koppers K-Spun Piston Rings, produced by centrifugal casting process, are *100% stronger . . . four times more resistant to combustion shock than ordinary rings! They will not break in installation or for the life of the engine.*

Koppers Porous Chrome* Rings have a porous chrome surface that holds and distributes oil during break-in, quickly wears down to perfectly seated solid chrome that prevents grit and other particles from embedding in the ring surface where they can scratch cylinder walls. Porous Chrome Rings last up to four times as long as other rings, reduce cylinder wear 50% or more.

That's why engineers everywhere are reporting amazing savings in equipment and maintenance costs through the use of Koppers Rings. Remember . . . we make rings for any equipment that uses piston rings.

*VAN DER HORST PROCESS

If you have a piston ring problem, why not get the *right* answer from us? Write, wire or phone Koppers Co., Inc., Piston Ring Dept., 1642 Hamburg St., Baltimore 3, Md.

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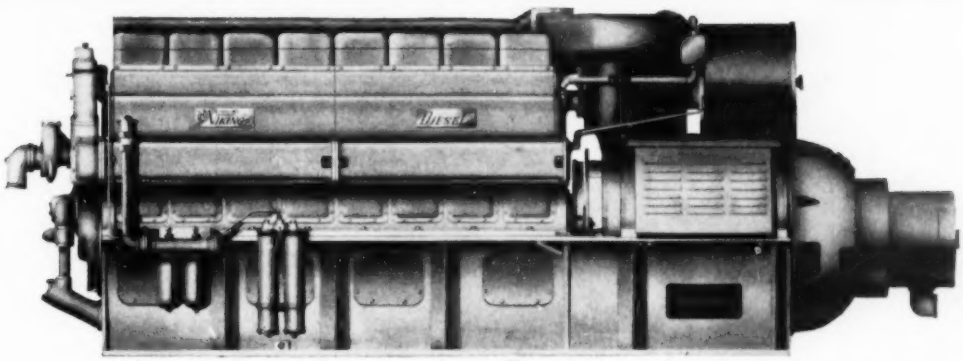
PISTON RINGS

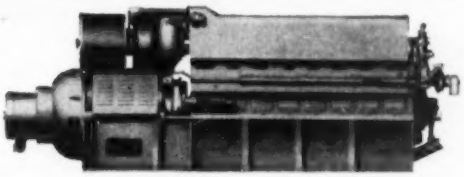
SPECIFY: Fast's Couplings . . . Koppers Piston Rings . . . both famous products of the Koppers Co., Inc.

ONLY KOPPERS CAN FURNISH K-SPUN OR POROUS CHROME!

Sterling Viking Diesels definitely lower costs of power production



Model VDS-8S, 600 KW Generator Set. Viking Diesel "packaged unit" generator sets are available in 6 and 8 cylinder models. Bulletins 1024 and 1028 contain sectional views, fuel consumption curves, engineering and installation details. Sent on request.



We have the evidenced facts to show any user of diesel electric generator sets that the newly engineered Sterling Vikings can cut KW hour production costs by as much as 50 per cent.

Fuel consumption, engine weight, compactness, housing, installation, parts cost, general maintenance — all are factors in the service worth of a generator set. On every point Vikings offer proven advantages confirmed by comparison. In diesel engineering, Sterling has come up with design developments that have the industry talking. We would like to give you this story of lower power costs first hand. Write us for latest Sterling Viking Diesel literature.

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● Depend upon Sterling Diesel Power for Locomotives, Generator Sets, Commercial and Fishing Craft, Lift Bridges, Ventilating Systems, Drilling Rigs, Etc.

Diesel, Gasoline, Gas—4, 6 and 8 cylinder—30 HP to 1,000 HP

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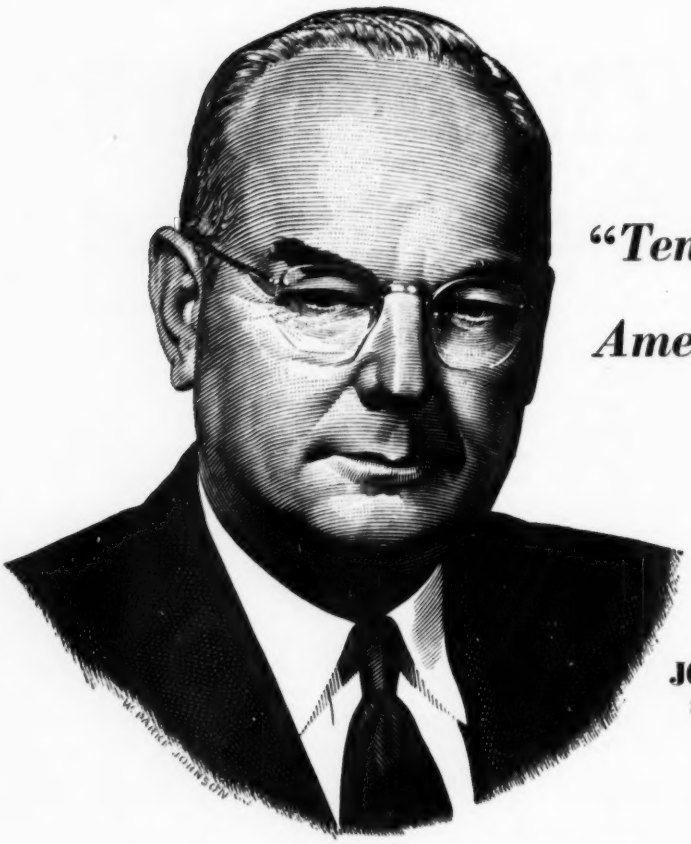

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JOHN W. SNYDER
Secretary of the Treasury

"Ten years ago America's business publications, as a voluntary public service, presented for the first time advertisements outlining the Payroll Savings Plan for the regular purchase of U. S. Savings Bonds, and urged its acceptance. During the decade which has passed, American business has consistently supported the Payroll Savings Plan and made it a success. Continuation of this cooperation with the Treasury is most essential in the present emergency. Expanded sales of Defense Bonds will assist importantly in checking inflation, in preserving economic stability, and in furthering the over-all defense effort."

In ten brief years:

- From 700,000 in 1941 employee participation went to 27,000,000 at the peak of the war.
- Companies with Payroll Savings Plans jumped from 10,000 in 1941 to more than 175,000 during the war.
- Since January 1, 1951, the number of men and women on Payroll Savings has grown from 5,000,000 to 6,200,000.
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- In the January-September, 1951, period, 33,418,000 $25 E Bonds were purchased—a gain of 17% over the same period of 1950. 8,966,000 $50 E Bonds were sold in the first nine months of 1951. *$25 and $50 denominations are the bonds bought by Payroll Savers.*

Congratulations to the executives of industry and the publishers of business papers for their continuing effort in promoting systematic savings through the Payroll Savings Plan—the plan that protects America and Americans.

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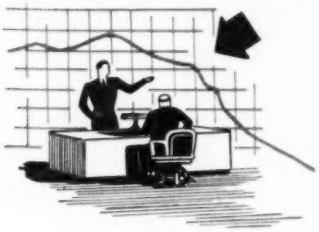
Beat In-Service Problems...



GUN IRON CAST PARTS

Emphasis, today, is on in-service economies, for two reasons: maintenance costs come high, and the critical need is to keep equipment on the job. And that's just one reason diesel manufacturers and operators in greater number are specifying Gun Iron for cast wearing parts. In thousands of applications, Gun Iron cast parts—superior in physicals—have demonstrated long life, PLUS lower operating costs.

Produced in air furnaces, "cooked" like open-hearth steel, Gun Iron has exceptional resistance to frictional wear, high heat, pressure, and erosion. Any of its many useful properties can be "pointed up" to meet your requirements exactly.

For diesel parts that are high in service life, low in service cost, investigate economical Gun Iron. You'll find our engineers and laboratory technicians ready and willing to help you discover Gun Iron's wide-margin advantage service-wise. **HUNT-SPILLER MANUFACTURING CORP., 373 Dorchester Ave., Boston 27, Mass.**

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***HERE IS A PRACTICAL GUIDE** for the user of iron and steel castings . . . 24 pages of technical data on many types of metals and alloys. Write for your free copy.*

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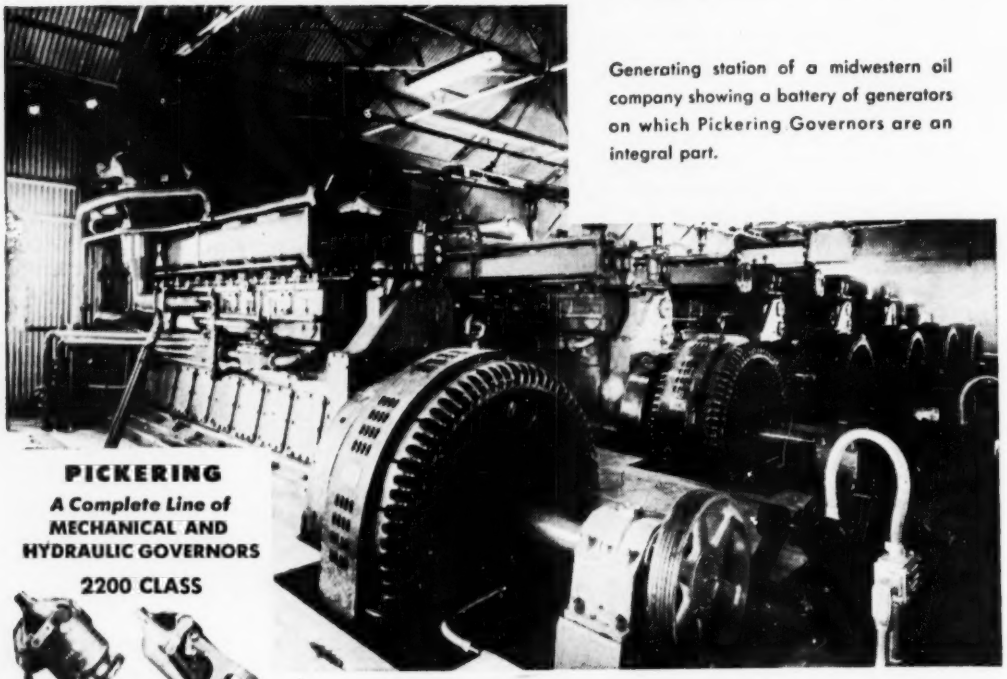

Generating station of a midwestern oil company showing a battery of generators on which Pickering Governors are an integral part.

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A Complete Line of
MECHANICAL AND HYDRAULIC GOVERNORS

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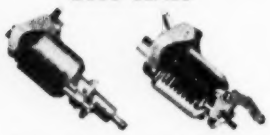
Constant Speed Variable Speed

2600 CLASS

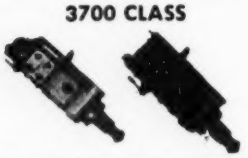


Constant Speed Variable Speed

3200 CLASS

Constant Speed Variable Speed

3700 CLASS



Constant Speed Variable Speed

For 89 years, Pickering Governors have met and anticipated the needs of American Industry. They have more than established a reputation for fully-dependable, long-term service under every type of operating condition.

Today, Pickering stands ready to supply the right governor for the job – to supply the governor that will maintain operating efficiency at its peak regardless of service conditions.

To consult Pickering Engineers may be your passport toward more efficient and economical operation of diesel equipment.

THE PICKERING GOVERNOR CO.

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HOW MANY TONS OF IRON TO STOP A TRAIN?

NOT LONG AGO the Santa Fe *El Capitan* wore out a ton and a quarter of iron brake shoes every 4500-mile round trip between Chicago and Los Angeles.

Today, thanks to General Motors Diesel locomotives, brake-shoe wear has been cut seventeen hundred pounds per round trip—saving on this one passenger train alone more than 600,000 pounds of iron a year. In *freight* service, the national savings in brakes and wheels on railroads using General Motors locomotives runs into thousands of tons annually!

This is because of a special brake applied first on the Diesel locomotive by Electro-Motive. It's the "dynamic" or electric retarding brake—an ingenious device that permits slowing a train at any speed without applying brake shoes to the wheels at all. The engineer simply moves a lever which converts the traction motors into generators. As generators they resist motion, so act as brakes—like braking with the engine in your car.

Add this saving to the many other advantages and economies proved in 17 years of main-line service, and it's easy to see why General Motors Diesel locomotives are one of America's greatest defense assets.

GM LOCOMOTIVES

Home of the Diesel Locomotive **ELECTRO-MOTIVE DIVISION**
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At right—one of two pumping stations serving Corpus Christi storm sewer system. Note "OC-H" filter at air intake of each of the three engines (pictured below).

AAF FILTERS Man the Pumps at Corpus Christi

CLEAN AIR HELPS KEEP ENGINES FIT FOR VITAL CITY DRAINAGE OPERATION

When it rains it pours in Corpus Christi, Texas, (as much as 2 inches in 30 minutes). Important links in this city's storm sewer system are two pumping stations. Their job —to handle all drainage when tides block outflow and to dispose of rain water when volume is too heavy for gravity-flow to clear.

Four of the five pumps are 75,000 gpm. units, each driven by a 325 hp. Fairbanks-Morse diesel. Although on stand-by duty, engines can be started and at work in one minute's time. Failure of this operation can have but one result—floods.

Naturally, dust protection is a "must". All four diesels are equipped with an AAF Type "OC-H" filter at the air intake. This low cost unit-type, washable filter is ideal for "hurricane service" because of its low resistance to air flow, high cleaning efficiency and large dust-holding capacity.

Dust protection can spell the difference between keeping your engines "in the pink" or "in the red". There's the *one* filter in AAF's complete line that can do your job at a reasonable cost. If it's dust —state your problem and we'll supply the right answer.

Today's Best Buy is Better Air!

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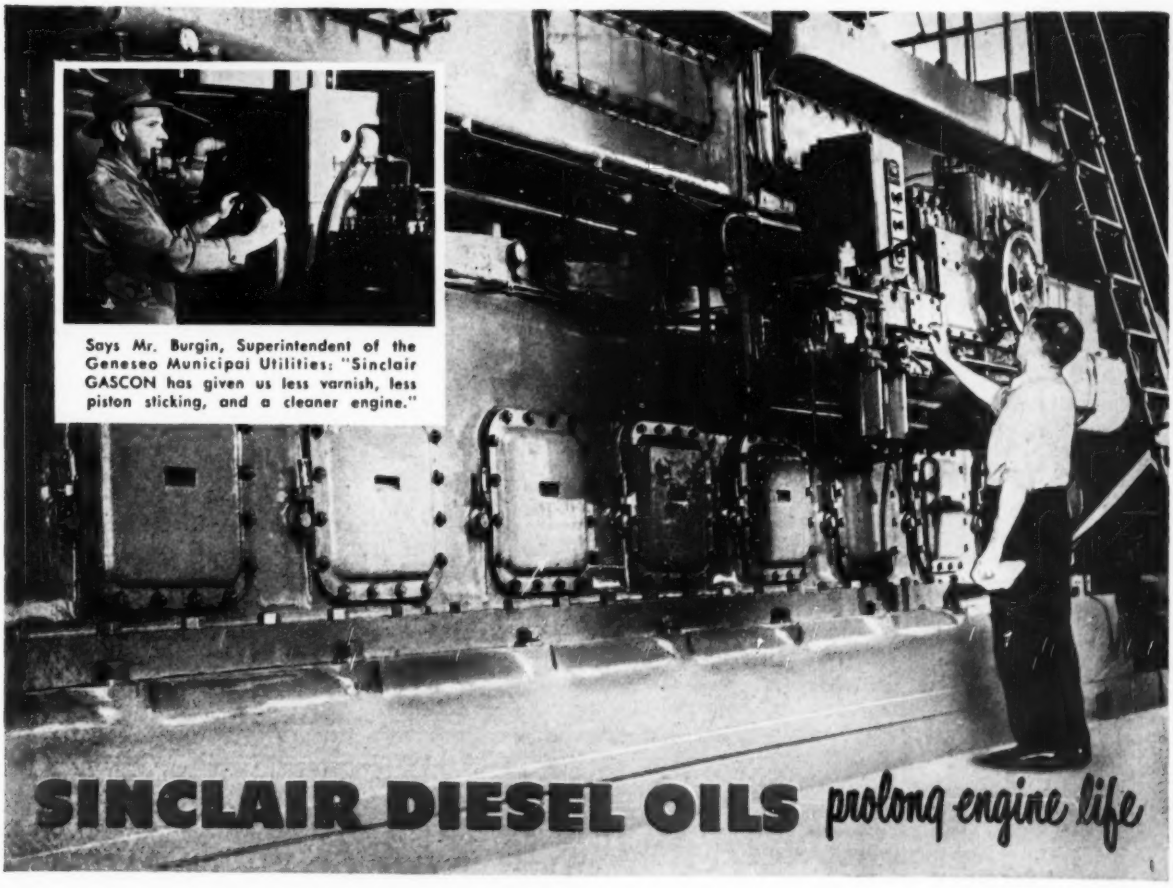
Light Plant Solves Problems of Sticky-Rings and Carbon-Build Up

● For quite some time the Light Plant of Geneseo Municipal Utilities, Geneseo, Ill., had trouble with sticking rings, and with carbon deposits in the exhaust ports of its diesels. A few years ago these diesels were changed over to Sinclair Gascon D. Almost at once, it was noted that the troublesome conditions started to clear up. In the time since, sticking rings have become the rare exception and the carbon deposits are no longer a problem.

Furthermore, in 1947, a 1400 hp. Fairbanks-Morse engine, shown below, was installed and filled with Gascon D. This engine has never had a sticking ring and is running remarkably clean, with exceptionally low cylinder wear.

Perhaps Gascon® Oil can cure *your* diesel troubles, too. Get in touch with your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Ave., New York 20, N. Y.


Says Mr. Burgin, Superintendent of the Geneseo Municipal Utilities: "Sinclair GASCON has given us less varnish, less piston sticking, and a cleaner engine."
SINCLAIR DIESEL OILS prolong engine life

EVERYBODY'S TALKING ABOUT CUTTING DIESEL OPERATING COSTS...

. . . more power with less fuel . . .
. . . low cost maintenance . . .
. . . lesson in cost reduction . . .
. . . cut Diesel overhaul 50% . . .

How about cutting costs of Diesels?

BFM rebuilt diesels save you up to ½ the cost of new engines—carry the same guarantee—can be delivered immediately! BFM also builds diesel equipment to your own specifications!

BFM techniques require that the entire engine be taken down to the original cast and all foreign matter removed. The diesel is rebuilt from the original cast and test run. Hydrostatic tests are performed on the block, head, manifolds; and with marine diesels, on the heat exchangers. All moving parts including crankshaft, camshaft, liners, pistons, etc. are micrometered to insure original specifications. BFM rebuilt diesels are guaranteed for 300 operating hours or 90 days from date of delivery whichever is prior.

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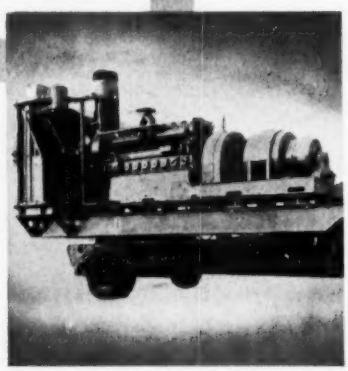
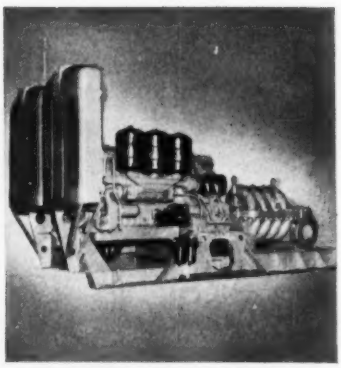
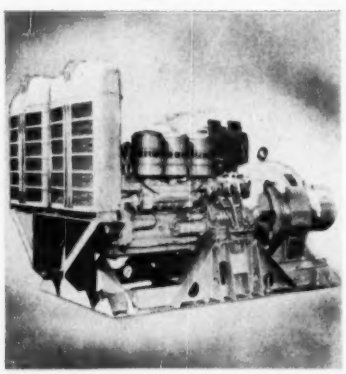
Immediate Delivery of All Famous Makes. Early Deliveries on Custom-Built Equipment. Complete Stock of Parts for GM and Gray Marine as well as accessories.



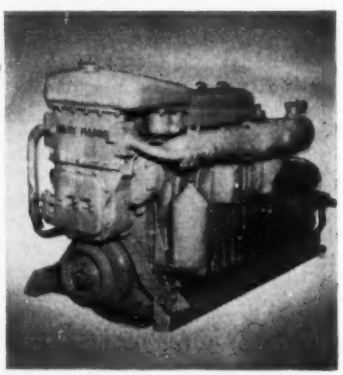
300 KW GM Cleveland Model 8-268A Radiator Cooled Portable Power Plant. The largest portable Diesel electric plant ever made.



Twin 6-71 GM direct connected to Gould 8" 4 stage Model 3330 centrifugal pump. Semi-portable unit. Made for Merritt-Chapman & Scott, Corp.



150 KW Twin GM Model 671 for Idlewild, New York's International Airport. Emergency standby plant for lighting and power.



Gray Marine Model 671 propulsion unit with any reduction desired. Complete stock of parts.

LET US AID IN ENGINEERING YOUR NEEDS. WRITE OR WIRE US TODAY!

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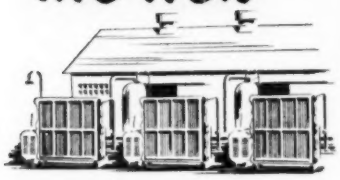
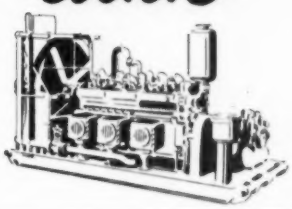
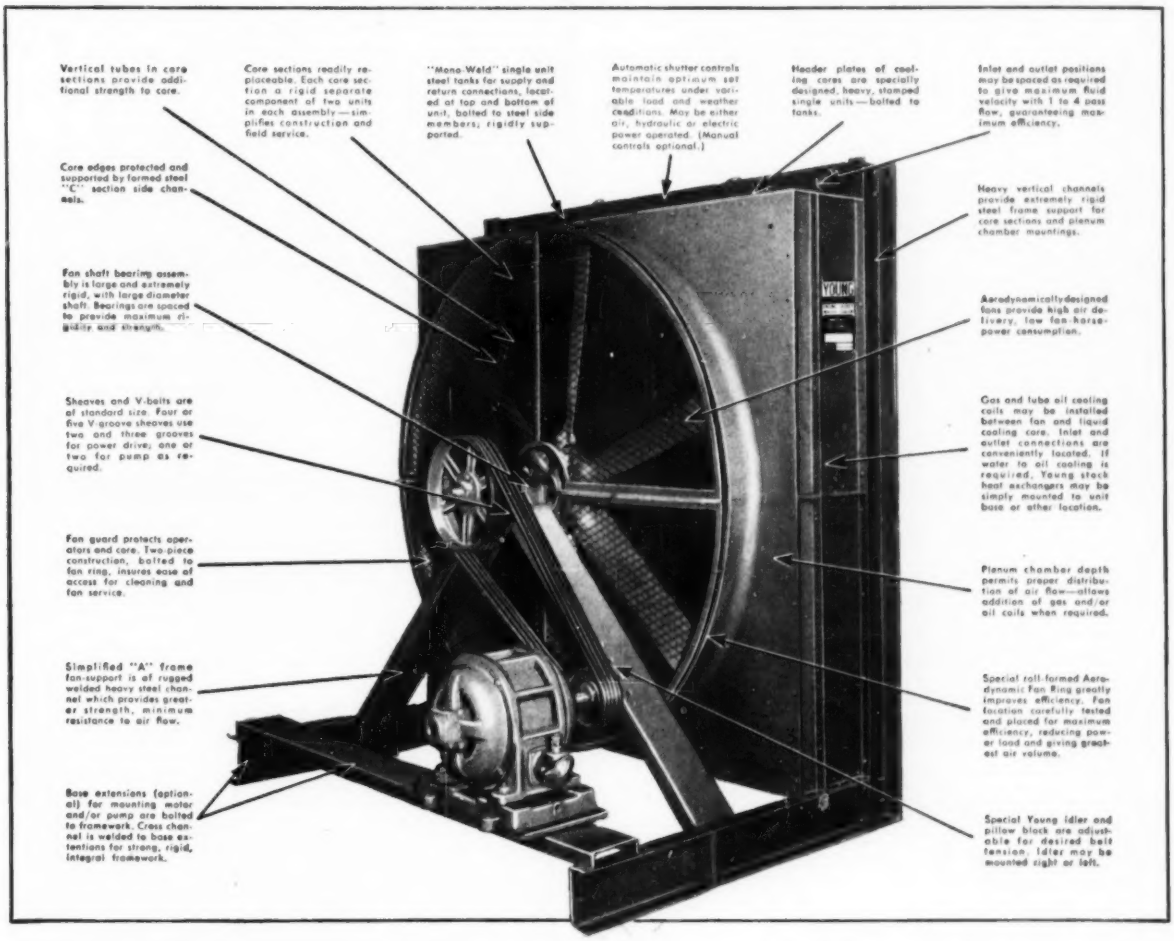


Greater cooling capacity...more compact, rugged design for stationary or portable Diesel engine applications




Vertical tubes in core sections provide additional strength to core.
Core sections readily replaceable. Each core section a rigid separate component of two units in each assembly—simplifies construction and field service.
"Mono-Weld" single unit steel tanks for supply and return connections, located at top and bottom of unit, bolted to steel side members; rigidly supported.
Automatic shutter controls maintain optimum set temperatures under variable load and weather conditions. May be either air, hydraulic or electric power operated. (Manual controls optional.)
Header plates of cooling cores are specially designed, heavy, stamped single units—bolted to tanks.
Inlet and outlet positions may be spaced as required to give maximum fluid velocity with 1 to 4 pass flow, guaranteeing maximum efficiency.
Core edges protected and supported by formed steel "C" section side channels.
Heavy vertical channels provide extremely rigid steel frame support for core sections and plenum chamber mountings.
Fan shaft bearing assembly is large and extremely rigid, with large diameter shaft. Bearings are spaced to provide maximum rigidity and strength.
Aerodynamically designed fans provide high air delivery, low fan-horsepower consumption.
Sheaves and V-belts are of standard size. Four or five V-groove sheaves use two and three grooves for power drive; one or two for pump as required.
Gas and lube oil cooling coils may be installed between fan and liquid cooling core. Inlet and outlet connections are conveniently located. If water to oil cooling is required, Young stock heat exchangers may be simply mounted to unit base or other location.
Fan guard protects operators and core. Two-piece construction, bolted to fan ring, insures ease of access for cleaning and fan service.
Plenum chamber depth permits proper distribution of air flow—allows addition of gas and/or oil coils when required.
Simplified "A" frame fan-support is of rugged welded heavy steel channel which provides greater strength, minimum resistance to air flow.
Special roll-formed Aerodynamic Fan Ring greatly improves efficiency. Fan location carefully tested and placed for maximum efficiency, reducing power load and giving greatest air volume.
Base extensions (optional) for mounting motor and/or pump are bolted to framework. Cross channel is welded to base extentions for strong, rigid, integral framework.
Special Young idler and pillow block are adjustable for desired belt tension. Idler may be mounted right or left.
YOUNG

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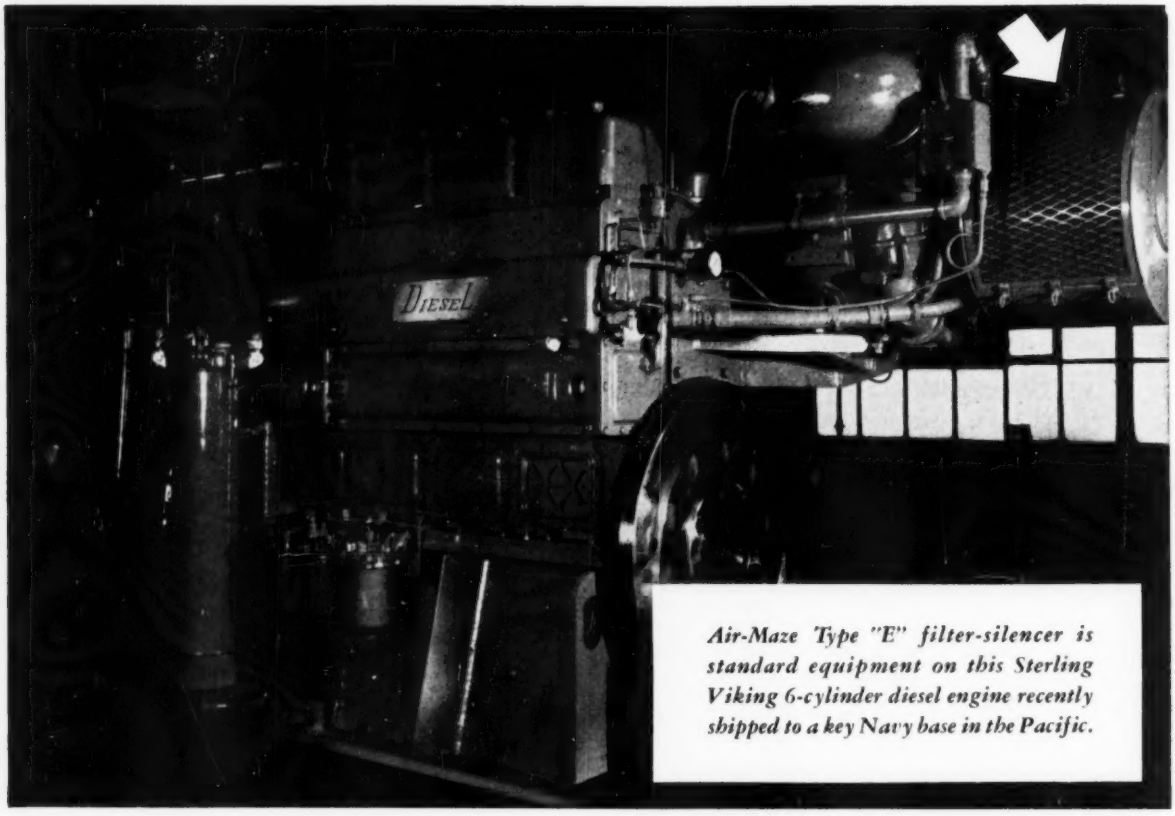
Catalog No. 1351 plus ratings, specifications and other details will be furnished upon request. See your nearest Young Distributor, or write direct.



Air-Maze Type "E" filter-silencer is standard equipment on this Sterling Viking 6-cylinder diesel engine recently shipped to a key Navy base in the Pacific.

Air-Maze filter-silencer cuts wear and noise on Navy's new Sterling Viking diesels

THE STERLING VIKING ENGINE above is one of two recently shipped to a Navy base in the Pacific. To assure long life and a minimum of intake air noise, the Sterling Engine Company equipped them with Air-Maze filter-silencers.

Air-Maze filter-silencers overcome intake air noise by means of a specially designed acoustical chamber. A permanent, cleanable filtering element keeps dust and dirt out of the engine, greatly reducing wear and keeping overhaul costs to a minimum.

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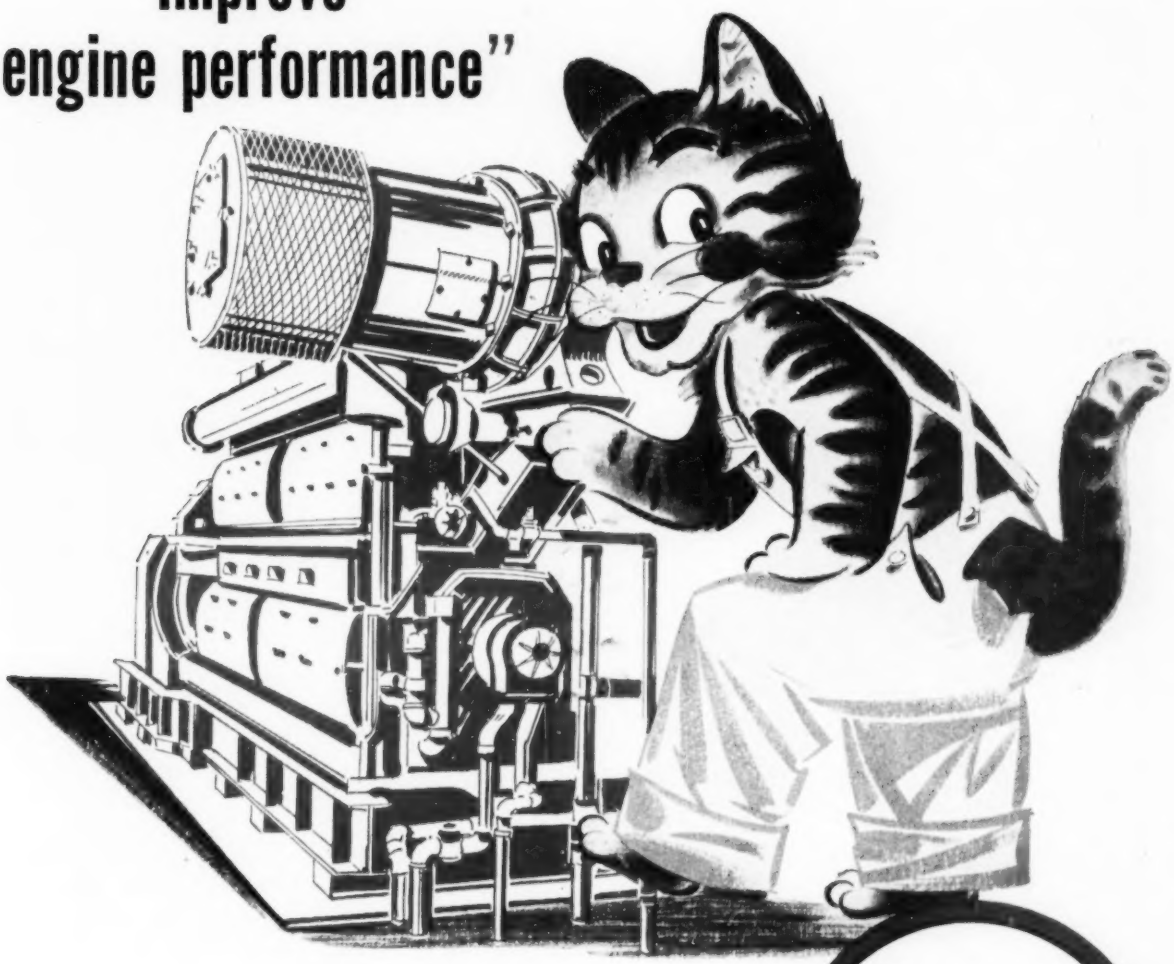

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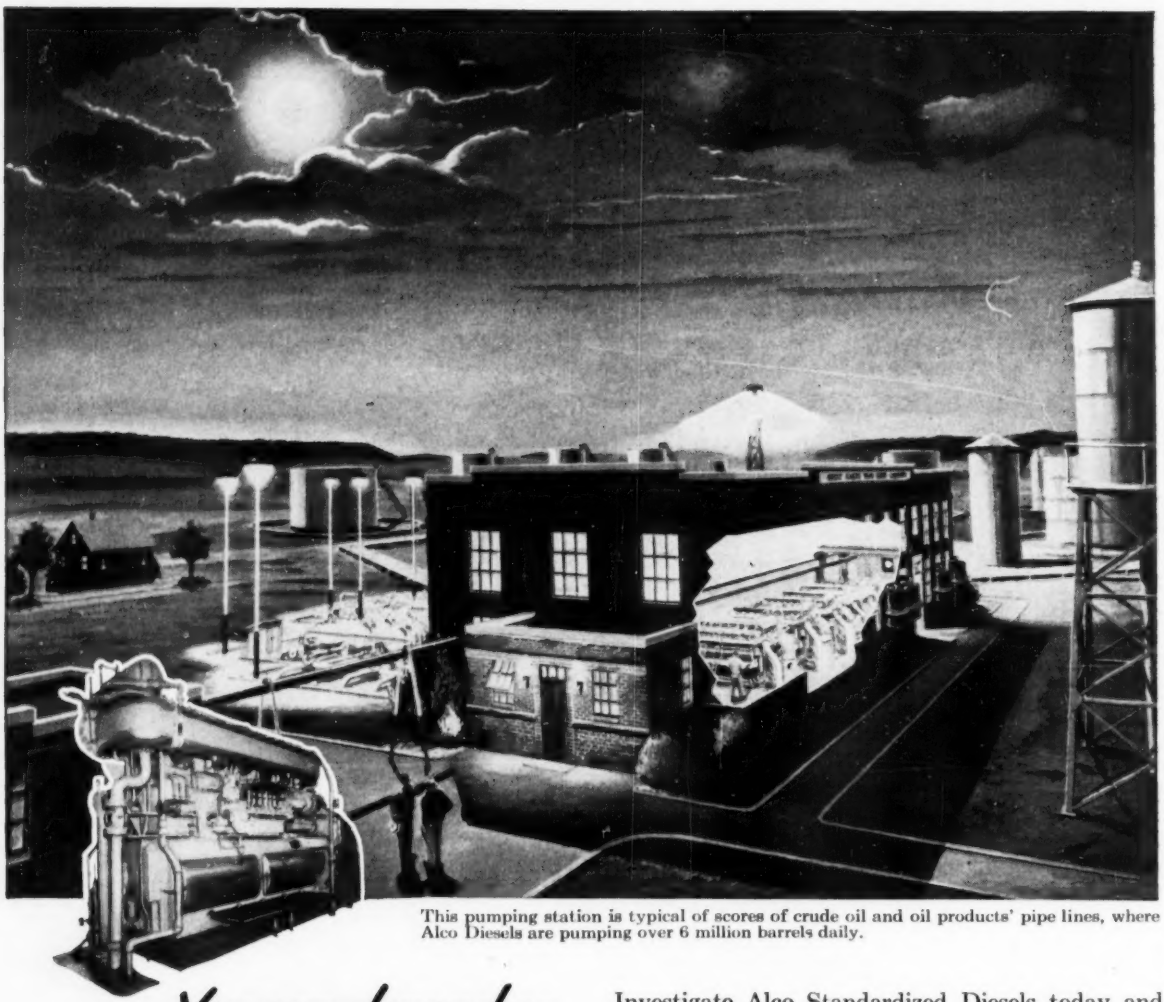

This pumping station is typical of scores of crude oil and oil products' pipe lines, where Alco Diesels are pumping over 6 million barrels daily.

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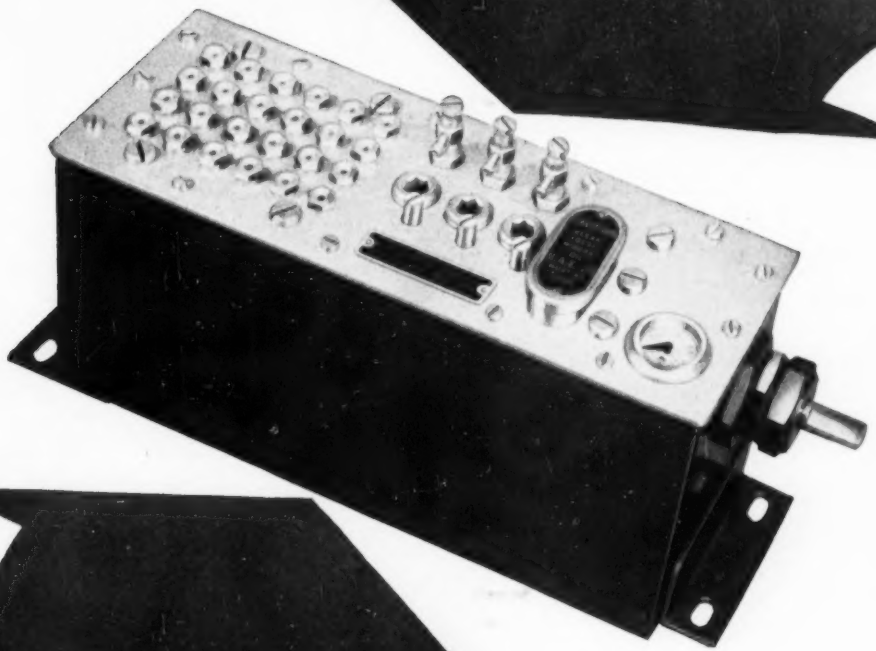

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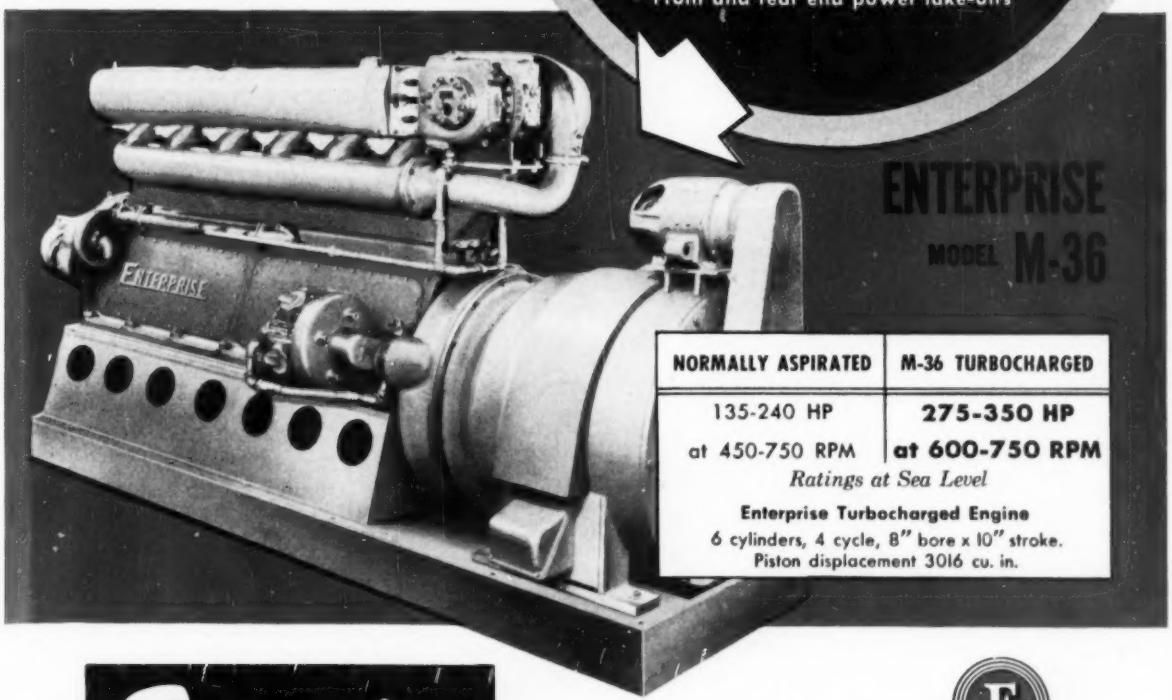

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Season's Greetings

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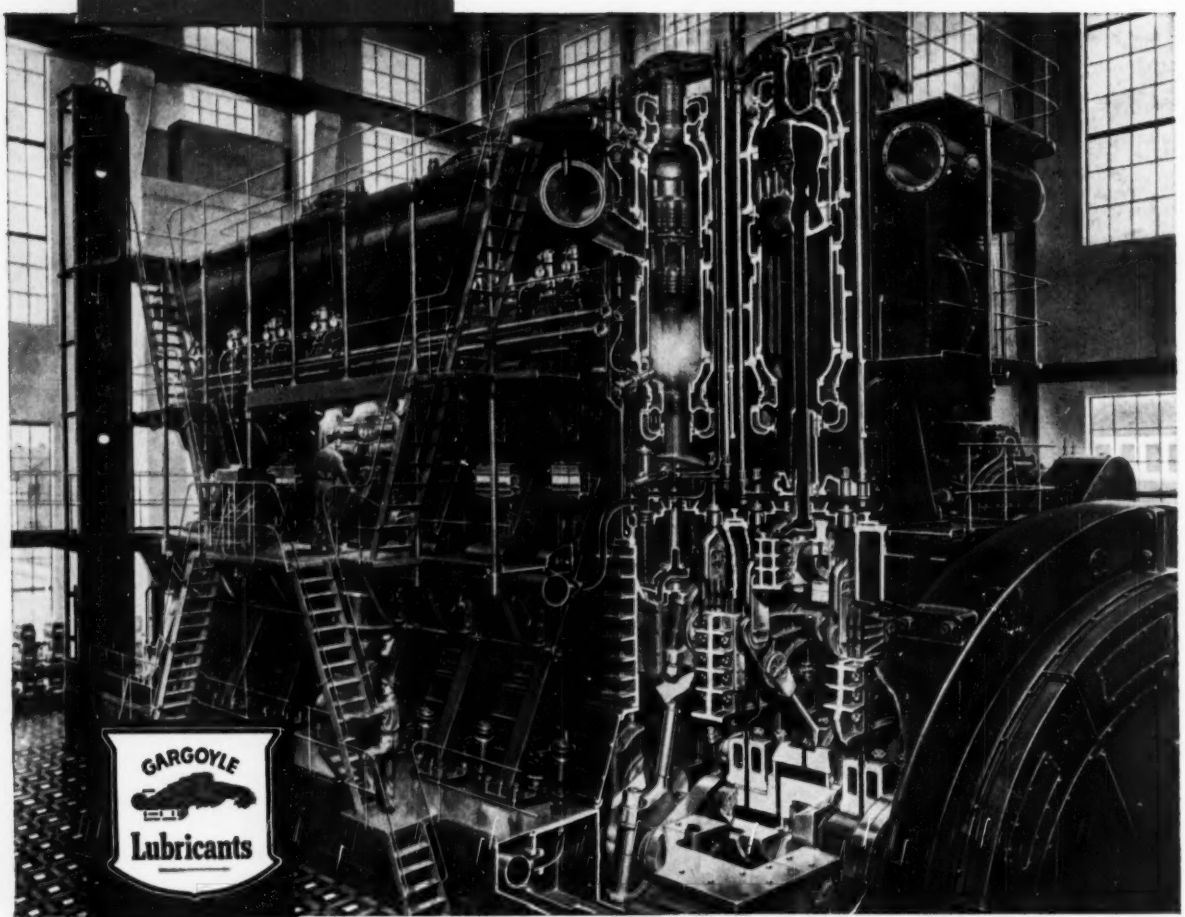

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Editorial:

A Modern Fable

And it came to pass that there were in the land groups of men skilled in the art of making a metal called aluminum. They labored mightily to improve their art for in times of peace there was much need for this metal. Great power was needed to produce this metal and these men in their wisdom saw that unless power was obtained cheaply the product would be of great cost.

God had bountiously endowed this land with the means for making this power, and its people with the art and skills to use this energy well. Great rivers were harnessed and the weight and velocity of their water used to turn machines. When the rain did fall and the snows far up in the hills did melt there was an ample supply of water for their needs. But, alas, there were times when there was not enough of this water.

Not on this power alone did these men depend. In another portion of the land was a fuel called gas, in good supply. For many years it had, to a great measure, been wasted. Those skilled in the art of building machines known as engines learned how to use this gas and do it well.

The makers of aluminum were quick to see the advantages of using these machines for the making of power. They did build vast structures and did make quantities of this desirable metal at a cost within reason. All prospered mightily.

These same machines were well suited to be placed in harness with the dwindling waters so that the power in these parts of the land could be sufficient unto the need. Unlike the horse, they did not eat when not at work and yet could be harnessed with no delay. They were not too costly and were quick to be installed.

And those plants that had been erected did prove the wisdom of those who were makers of aluminum for they produced the metal at the lowest cost for power, excepting where the waters could be depended upon to flow. Surely, here was an omen.

Not alone was this metal of use to the peaceful pursuits of the people; it had great use for the machines of war. The flying machines that could wreck such havoc upon the enemy were specially dependent upon it. And it came to pass that there was an enemy and it became needful to build up the sinews of the country. So, those who governed the people, residing in a place called Washington, did say to the makers of the metal, "Ye shall make more aluminum for we must have enough for our people, for our war machines and for those people who are our allies."

Indeed, the task was great, but to this end two new plants were undertaken after the pattern of these producing so cheaply and one structure was expanded. But in this land were many who were advocates of other forms of power and who had great influence among the lawmakers. Also there were among the lawmakers those that coveted for their home areas the coin that would be spent. This, for political advantages.

Gas was denied to one group of metal makers and they were told. "We fear for our supply, but there are those among us who would sell ye power." By strange chance, a powerful group of local citizens who had a little power for sale courted their favor. Greater amounts to satisfy the full plan were contingent upon the time when a power plant of an uncommon type would be completed in the distant future. Even the wise among the lawmakers in Washington, place of divided opinion, decried this project, but their voices went unheard.

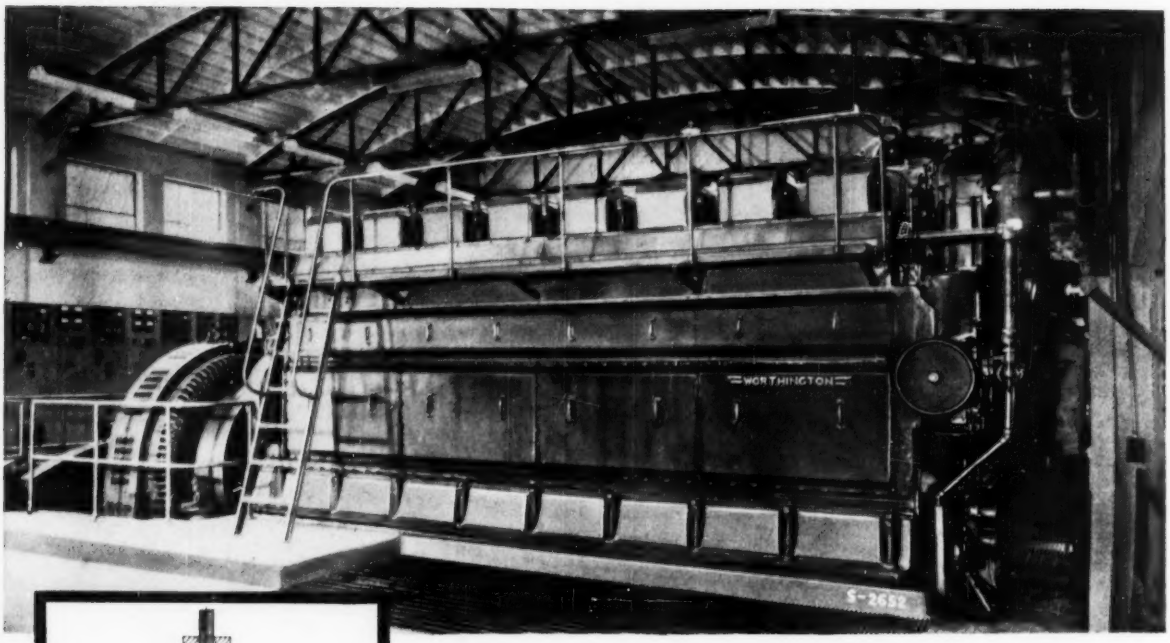
One metal maker planned to erect another plant in a portion of the land distant from where he had one in operation. He was warned of reprisal if he did not spend his gold in this same area. To his claims that there was no more low cost fuel in the area, he was offered power at an artificially low cost to sweeten the bitter draught. Also, in this offer was no regard for the welfare of the local people who would suffer power shortages and greater tax burden in time to come.

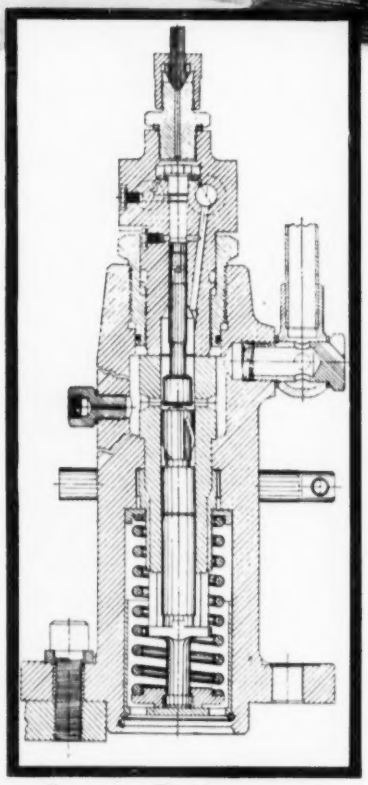
Where the waters of a mighty river had been harnessed and yet the elements had forsaken them so there was a great shortage of power, the metal makers were unable to continue full production. There was much talk of a power plant to provide the energy lost when the waters dried up.

Lo and behold, the plans were for another new type of plant. The machines, called gas turbines, were to be of a design and size never before built; they needed many scarce materials vital to the rebuilding of military might; and none among the soothsayers could say when they would be completed.

And who shall suffer this loss? The country and those who pay its burdensome taxes; the makers of the metal; and the makers of the machines known as engines who have labored diligently such that all shall reap the benefits of low cost power.

Moral: *Those who build better mouse traps should expect that the path to their doors will have plenty of detours. It is not the path that is beaten, but the taxpayers.*





Cross-section, Worthington patented dual plunger fuel pump.

This Diesel Is Ready

FOR A CHANGE IN DIET

Right now this Worthington Diesel—one of three 1760 hp units owned by the city of Tarboro, N. C.—is operating on oil.

But they anticipate natural gas in this area, and this Diesel is ready for it. With slight changes, it can easily be converted.

Worthington's patented dual plunger pumps now completely fuel this engine with oil—producing more perfect atomization, making possible the use of a *heavier* grade of oil. Also: firing pressures are reduced, exhaust temperatures, too, and combustion is improved.

When the conversion to gas is made, the dual plunger pumps will furnish pilot oil for ignition. Conversion is made quickly and at low cost.

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Only Worthington dual fuel engines offer such exclusives as dual plunger pumps, gas micro-metering valves for each cylinder, and automatic thermal air control—all built to give optimum performance for the fuel used.

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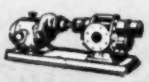

Oil Transfer Pumps

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+ HIGHLIGHTS +

● Van Der Horst Co., the chrome plating people, are aiding the war effort by application of their process to gun barrels.

● At the present time British machine tool manufacturers have over $2,000,000 worth of American orders on hand for 1952 delivery.

● Pipeline operation is becoming a fertile field for the communication boys. Recent applications to promote more efficient operation include telegraph, teletype, radio, and radiomicrowave systems. What! No television?

● A new process for "plating" coatings of refractory materials to meet the needs for high temperature-resistant materials in gas turbines and other high temperature service has now been developed.

● Cement dust plus water equals concrete. This was one reason for Boston Sand and Gravel Company to switch from gasoline to Cummins-powered trucks for transit-mix cement operations. Moisture and cement dust fouled up the ignition system.

● An agreement between Northwest Natural Gas Company and Canadian Gulf Oil Co. has been concluded for disposal of Southern Alberta's big Pincher Creek Gas Reserve over a twenty-five year period. Dual fuel engines should find application in this area with such a promising source of fuel.

● In an effort to help the small business man conserve those hard-to-get machine tools the Office of Small Business, National Production Authority, has issued a pamphlet on lubrication materials and methods. Specific suggestions are offered for selecting lubricants, for oiling and greasing different parts of machine tools, and for storing lubricants.

● Twelve diesel locomotives were delivered to the Long Island RR recently by the Fairbanks, Morse Co. With the new engines, all steam locomotives will retire from passenger service.

● No rationing of petroleum products is foreseen during 1952, although local shortages may occur during the winter months if transportation facilities become overtaxed.

● Air Materiel Command's Supply Division reports that in the fiscal year 1951 approximately 1,000,000 gal. of aircraft lube oil has been re-refined by contractors and had been put back into service. Recovery from used stocks was about 71.9 per cent. Speaks well for the re-refining when properly done.

● Aluminum production for September was off 6 per cent from August due to the Northwest power shortage. Possible remedy here could be some diesel electric plants.

● 5000 machine tools valued at $80-million now in Air Force custody will be made available to Army and Navy contractors. Tools selected by contractors from storage will be transfered to the Army and Navy, who will then lease tools to the contractors.

● A speedy new method of determining the endurance limits of metals and alloys has been developed at Rensselaer Polytechnic Institute. It was discovered that metals when heated expanded in proportion to the stress the sample already had undergone, permitting accurate determination of the material's endurance limit.

● A four year program to standardize the high-mortality parts of gasoline engines used by the Armed Forces is nearing completion. Maximum interchangeability is also being achieved. The program will also be expanded to cover diesel engines.

● Increased supplies of nickel and molybdenum are forecast for 1952, but the situation will still remain tight.

● With the present price of crude oil at about the same level as four years ago, some segments of the oil industry are working hard for a price raise.

● DPA-NPA Administrator Manly Fleischmann recently declared that we do not have a problem in this country more serious than the task of getting scrap to the mills and foundries. Scrap means not only steel but brass, copper, lead, zinc, bronze, and aluminum as well.

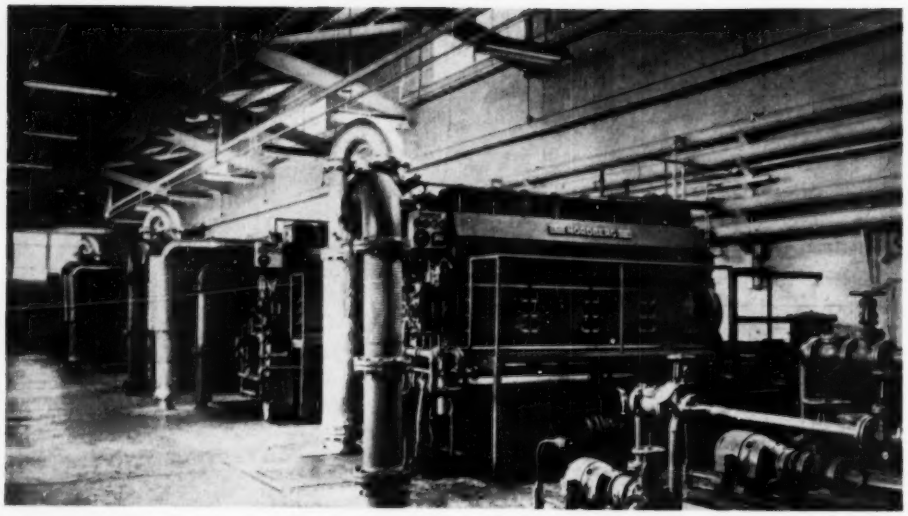
● Motor carriers subject to New York State truck mileage tax were required to file their first monthly tax returns recently, even though payments cannot be enforced until the court renders a decision on the constitutionality of the new law.

● A coal hydrogenation plant is now producing 200 bbl. per day of satisfactory gasoline from various grades of coal and another plant with a capacity of 60 bbl. per day is producing gasoline and other liquid fuels from coal by a gas-synthesis process.

● A "quality booster" for the diesel fuel is being tested by the Navy. Apparently a cetane improver, it is described as a blend of several amyl nitrates developed by the Ethyl Corporation. When added, in proper quantities, to lower grade fuel or an assortment of grades, it is said to bring them up to Navy requirements.

● Col. Harley L. Swift, president of the American Transit Association recently told the National Defense Transportation Association at their annual conference that 700 new transit vehicles would be required in 1952. A good percentage of these should be diesel powered.

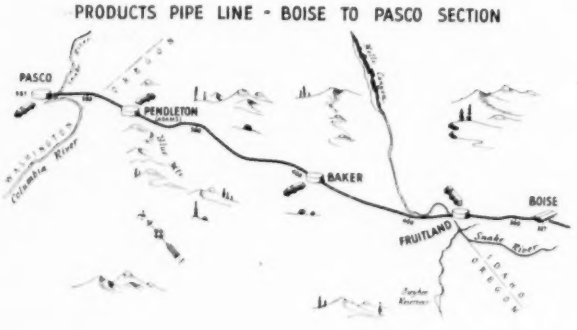
Refinery



Engine room of the Hanna pumping station on the Rangely Salt Lake pipe line. This station employs three Nordberg engines rated at 310 bhp. at 535 rpm. and operate on crude oil only.

by Milo D. Pugh

$35,000,000 pipeline is helping Standard Oil of California keep the prices of its' products down to little more than pre-war level.



UNTIL about two years ago Standard Oil Company of California supplied its customers in Idaho, eastern Washington and Oregon by tank car and highway tank truck from its refineries in California. With the expansion of the oil fields in Western Colorado and the growing demand for petroleum products in the area, the company decided to embark on an expansion program which involved a three-fold project.

(1) A pipeline to bring crude oil from the Colorado wells to Salt Lake City.

(2) A refinery at the terminus of this crude line.

(3) A product pipeline to deliver gasoline and other refined products to the consuming area.

In the Spring of 1948 work was started on the crude pipeline which was completed in November of that year. While this crude line was being laid the refinery at North Salt Lake City was completed sufficiently in the record time of only eight months to take the crude and refine it into gasoline, stove oil, diesel fuel, furnace oil and industrial fuel oil.

During the first year of operation, this refinery handled over 6,000,000 bbl. of crude. A further expansion has recently been completed which provides a total capacity of approximately 24,000 bbl. daily.

The products pipeline to Boise, Idaho was finished in 1949 and has now been extended to Pasco, Washington on the Columbia River where these products are trucked or barged to surrounding points. The products line is now 567 miles long. Of this, 505 miles is of 8⅝ in. diameter pipe with the last 62 miles of 6⅝ in. diameter pipe. Total amount of steel used was 33,000 tons in 40 ft. lengths and the line itself holding a total of 7,500,000 gal. of oil products.

A necessary part of the products line is a communications system which keeps all stations in touch with each other and with the dispatcher at the refinery. Since different types of fuel are moved in the line, the location of each batch must be known at all times and the bulk storage terminals kept advised when they can take their next delivery of the products needed. A chemical tracer is used in the line which has been exposed to atomic radiation bombardment. This radioactive chemical is diluted many times by its volume in oil and becomes a tracer liquid. A fraction of an ounce of the diluted tracer liquid is added to the oil stream between the two products in the line. Sensitive Geiger counters show the arrival of the tracer at several points upstream and thus announce to the station in ample time so that the take-off can be made at the moment of arrival of the product. This tracer material is self-destroying and its radioactivity falls off rapidly with time and is utterly harmless by the time it reaches the consumer.

At the Pasco terminal there are now eleven storage tanks which range in capacity from 8000 bbl. to 55,000 bbl. The total storage capacity is approximately 325,000 bbl. Five of these tanks are for storage of stove oil, two for diesel fuel and the remaining four for two grades of gasoline. At Pasco are also two tank truck loading racks each of which is double sided so that

Uses Pipeline For Supply and Distribution

as many as four tank trucks may be loaded at one time. The motor transport includes 25 large mostly diesel powered trucks and trailer units and a service building.

Other recently completed take-off terminals are located at Pendleton and Baker, Oregon and Fruitland, Idaho. The Fruitland terminal has storage capacity for approximately 30,000 bbl., Baker 26,000 bbl. and Pendleton for 98,000 bbl. Previously completed terminals are located at Ogden, Utah and Burley, Twin Falls and Boise, Idaho.

The crude line as well as the products line is owned by the Salt Lake Pipe Line Company, a subsidiary of Standard Oil Company of California. The crude line known as the Rangely-Salt Lake line runs from Rangely, Colorado with an elevation of 5200 ft. to North Salt Lake City, a distance of 180 miles. The elevation at the Salt Lake terminus is 4355 ft., but at Wolf Creek Pass in the Uinta Mountains, the line reaches an elevation of 9560 ft. and is one of the highest crude lines if not the highest in the world.

Three pumping stations are required to force the crude up the mountain side. The Rangely station near the beginning of the line has three Nordberg FS-G-SC duafuel engines 9 by 11 in. rated 442 hp. (derated to 365 hp. due to elevation) at 530 rpm. The fuel for these engines is natural gas taken from the field. Crude oil is used only as pilot fuel. These engines are 4-cycle, mechanical injection, supercharged type each driving a National Transit reciprocating horizontal 4¾ by 18 duplex plunger pump at 71 rpm.

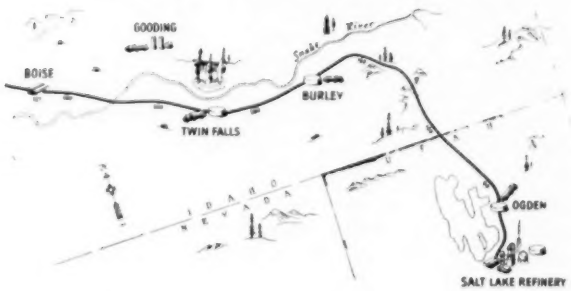
Testing joint welds for defects with X-ray equipment on the Salt Lake—Pasco products pipe line.

The Myton pump station located approximately 40 miles from the Rangely station and the Hanna pump station at the foot of the Uinta Mountain 50 miles beyond the Myton station, each has three Nordberg diesels which operate on crude only. These are FS-G-98-SC engines rated at 310 bhp. at 535 rpm. and the pumps are the same as those at the Rangely station.

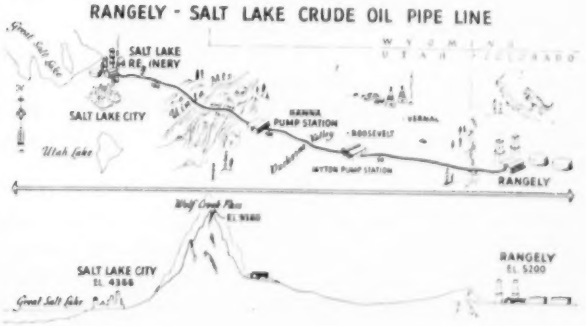
The products line has only one diesel powered pumping station which is located at North Salt Lake City. This is equipped with three Nordberg FS-96-SC 310 bhp., 535 rpm. at 4300 ft. The pumps at this station are the same as used in the crude line, except that they are 3¾ by 18. The products line has two other pumping stations, but these are driven by electric motors, because of the availability of electric power.

The total investment in the pipelines, refinery, storage and marketing facilities runs upward of $35,000,000. Yet, because of the savings made, the price of the gasoline delivered in Boise was reduced by 1.2 cents a gallon and diesel, stove and furnace oils by 0.7 cents a gallon. This in aggregate means considerable saving to the consuming public. What has been done here is but an example of what has been done in other localities by the petroleum industry since the war to meet the rapidly growing demand and to better serve its customers as well as to keep down the price of its products to where these are but little more than pre-war.

PRODUCTS PIPE LINE - SALT LAKE TO BOISE SECTION

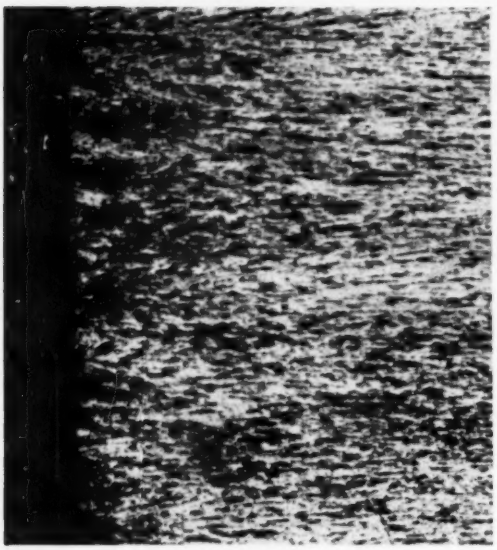


RANGELY - SALT LAKE CRUDE OIL PIPE LINE



A practical and economically attractive method for "standardizing" worn cylinder liners and other parts where high quality iron wearing surfaces are suitable is provided by . . .

Vanderloy M



Vanderloy M as seen through the microscope at 100 X showing fibrous or fine columnar structure.

The need, the economics, characteristics of the new surface metal, details of the process and the available facilities are discussed.

CYLINDER liner wear continues to be the subject for much research and development. Liners rate somewheres about third among the major engine components in frequency of replacement and are probably first in unit cost.

Solution to the problem has been sought in better design; metallurgy of the mating surfaces; improved lubrication; filtration of air, fuel and water; and chrome plating of either the liner bore or the piston rings. All of these have helped and wear rates are reasonably under control in view of the functional conditions.

Unlike many other engine components, there has been no practical means to restore badly worn liners to standard size. Reboring to oversizes has the disadvantages of requiring new pistons, introducing non-standard sizes and the necessity during design to leave extra stock in anticipation of this action. Chrome plating (Porus-Krome) has the ability to greatly extend liner life but cost factors limit its use to comparatively thin applications (approximately 0.030 in. maximum on the diameter) as a means of liner reclamation or "standardizing".

NEED FOR A CHEAPER METHOD OF RECLAMATION having wider application is apparent. This was the incentive for the Van der Horst Corporation of America to develop such a method which has now been introduced under the name of "Vanderloy M".

After a study of known methods of electro-depositing iron (several experimental licenses were taken) it was decided that they were all lacking either in the physical properties of the iron deposited or in the stability of bath for production operations. It took considerable research to arrive at a new electrolytic bath without these deficiencies.

RESULTS ARE IMPORTANT for several reasons. The first and perhaps the most important is that it permits liners to be restored to standard size at a cost of at least a third less than that of a new liner. It also keeps parts standardized and eliminates the need for stocking oversized pistons and rings.

There is another factor in these particular times of materials shortages. New parts are getting scarce and hard to get without considerable lead-time in ordering. To the operator, "lead-time" is frequently "down-time". In contrast, "standardizing" by this process is a relatively short process.

The saving in critical materials, man-hours and machine hours is also an important factor. Quoting a typical example, a 20-in. liner can be renewed by application of an average of 12.3 lb. of Vanderloy M. This saves about 1720 lb. of high quality casting and expensive machining the replacement cost for which is approximately $1550.

OTHER APPLICATIONS FOR THE PROCESS are equally advantageous. It applies to just about any wearing surface where the characteristics of iron are suitable. One of the specific uses at the present time is for the restoration of the bearing surfaces of crankshafts.

CHARACTERISTICS OF THE ELECTRO-DEPOSITED IRON are an important consideration in obtaining optimum wear

rates. This new electrolytic iron, examined microscopically, shows a fine columnar structure with the closely packed grains perpendicular to the bond surface. This would appear to offer good grain-on-end resistance to wear, in a manner similar to the use of grain-on-end wooden blocks for heavy duty factory flooring.

There is a notable absence of any graphite. Incidentally, one of the research projects under way is to perfect a method of controlled graphite plating along with the iron plating so as to produce deposits with the desired graphitic distribution in colloidal or spheroidal form.

Variations in bath composition and plating conditions can produce deposits with tensile strengths varying between 50,000 and 10,000 psi. tensile strength. Current production practice has been established to produce the following average physicals:

Tensile Strength, psi.	75,000
Yield Point, psi.	60,000
Brinell Hardness	200-210

Laboratory indications point to the possibility of adapting the bath to alloy plating. The alloy program, however, is a long term project.

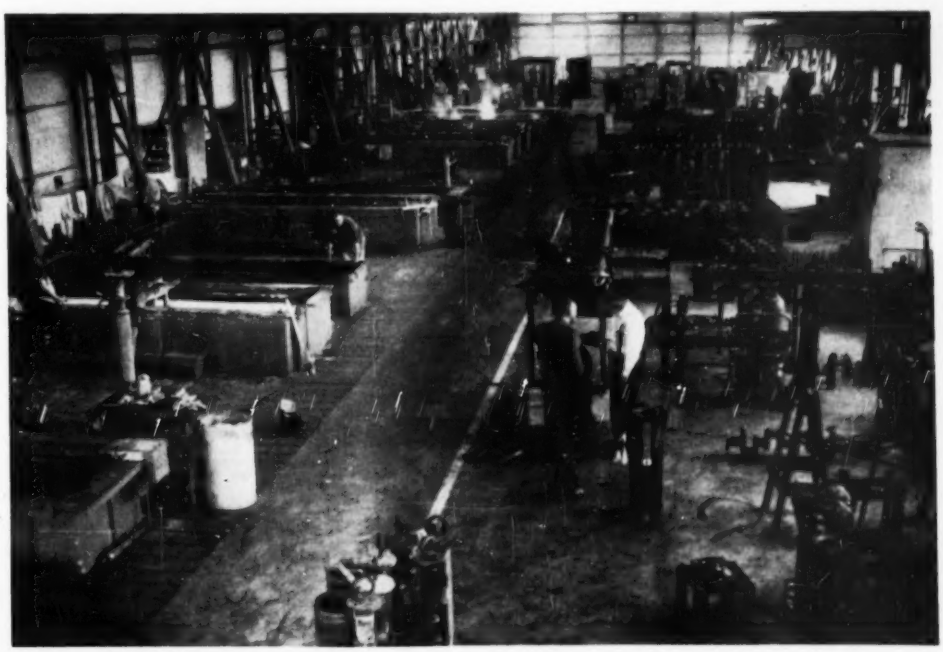
Machinability of Vanderloy M on outside surfaces is about the same as for alloy steels, having a tendency to be tough. Inside bores are more difficult but respond readily to grinding and honing.

Typical group of parts as they are received at the plant. Shipped from all parts of the country, they vary as to type and method of packing.

Fatigue tests are now being conducted to determine the endurance limit of the Vanderloy M and its effect on that of the base metal. Expectations are that it will follow the pattern of all ferrous metals and have a limit for complete reversal of about 40-50 per cent of its ultimate strength.

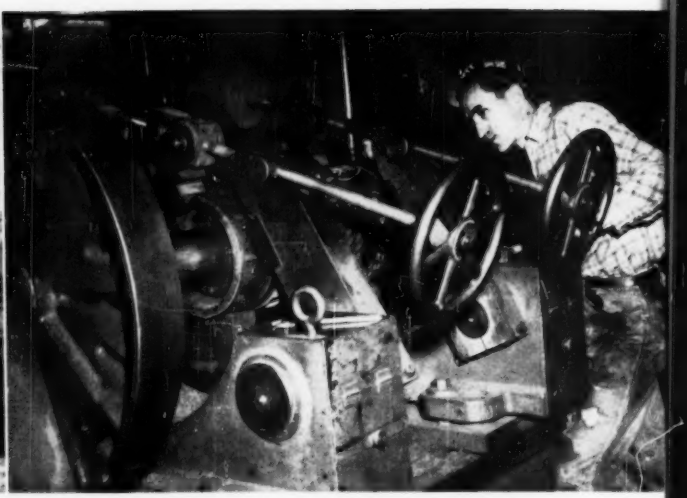
STRENGTH OF BOND is always important with respect to plating, overlays, etc. In this case, the bond is atomic. The metals are essentially similar and an intermingling of the orbits of their atomic structure is attained. Forces sufficient to tear one of the metals apart fail to disrupt its atomic adhesion to the other.

THE PROCESS is well suited for plating heavy deposits as no evidence of excessive grain growth or roughness is observed. Deposits of ¼-in. radial

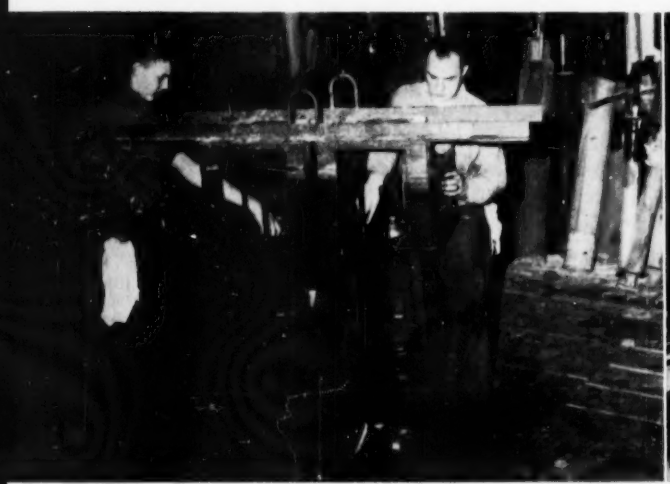


General view of the new plant. Area at right is devoted to preparation of parts to be "standardized". Plating tanks are at left with final finishing in the background.

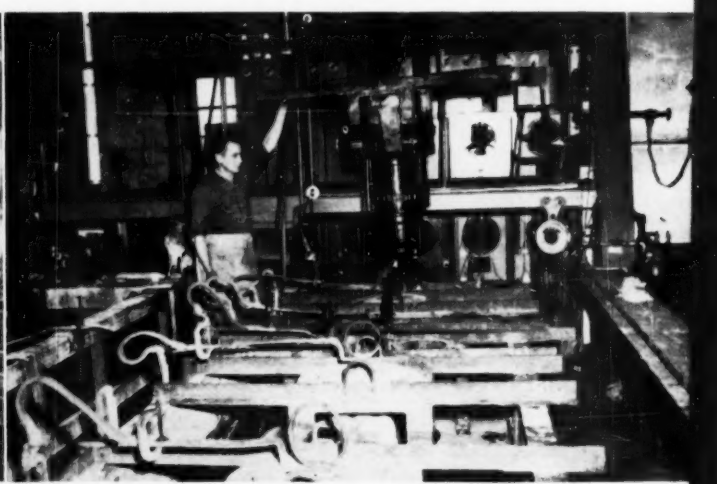
Illustrative of the first step in "standardizing". Thorough preliminary cleaning is required to remove grease, carbon, rust, etc. In addition, oil soaked parts are "baked" to dispose of petroleum residues.



Restoring geometric accuracy of a typical cylinder by boring. This step is important not only for the purpose of removing dimensional discrepancies but also because it produces a suitable plating surface.



Once the ports of cylinder liners of the type shown are painted to stop-off plating deposits the entire liner is dipped in a masking wax. The operation shown is the removal of the wax from the surfaces to be plated.



Liners, individually mounted in fixtures, are lowered into the plating bath. Individual control circuits are provided for each unit. Connections can be seen at left. In the background, partly obscured, are some control panels.

thickness, or more, can be made. Actually, economics and design are the limiting factors.

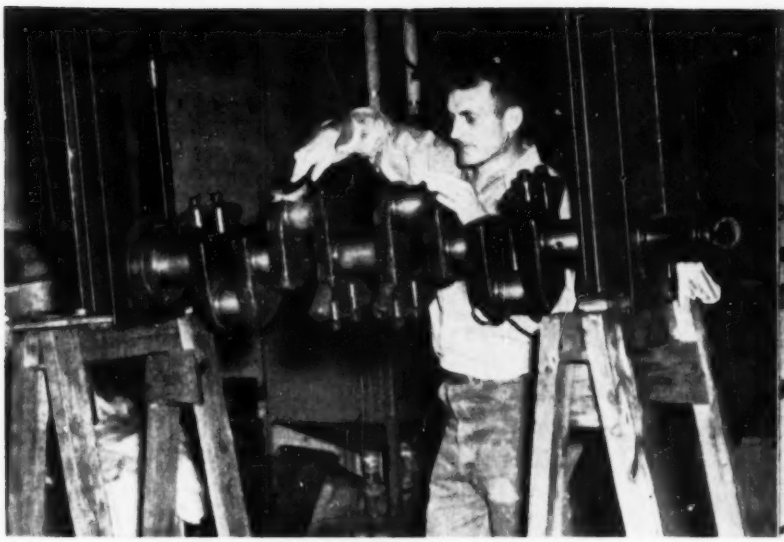
There are two phases to the process; preparation and the actual plating. Preparation, as in general plating, consists of degreasing; anodic alkaline cleaning; stopping-off of areas not to be plated; and just prior to plating, anodic etching in a sulfuric acid bath.

After cleaning and rinsing, but prior to the stopping-off operation, worn surfaces are cleaned up and made geometrically accurate by machining. It is also necessary, on surfaces such as in liners that have been oil impregnated over a long period, to bake out or carbonize this residue to prevent later seepage or bleeding.

Unlike chrome plating, iron plating has good "throwing" power. In other words, while chrome deposition will take place only opposite the anode, iron deposits will wander considerably. Areas such as cylinder liner ports are masked with paint and other more general areas masked by dipping in a bath of molten max.

Plating takes place in one of a series of tanks. The control set-up is such that the plating current for each individual part can be adjusted to the particular job. Again, in comparison to chrome plating, the efficiency of the plating operation is higher; current densities can be lower; and, of course, the plating material is cheaper.

Note that in the preliminary alkaline and sulfuric baths the work is the anode, thus minimizing the absorption of hydrogen. During plating the work is of necessity the cathode and some hydrogen is occluded, but the total is minimized. The possibility of hydrogen embrittlement is not serious in the case of Vanderloy M depositions in liners as tensiles and elongation of the thin layer are relatively unimpor-



Crankshafts are mounted in special fixtures permitting rotation during plating. Stop-off wax coats portions not to be plated. Here, a crank pin is getting a final cleaning.

Current densities must vary with different parts. These control panels permit adjustment.

tant. However, on parts subjected to stress, such as crankshafts, it could be serious and a heat treatment of several hours at 600° F is used to effectively drive off the hydrogen.

The plating bath is the crux of the entire operation. Distinguishing features are its stability and the capability of producing the desired results within practical limits of current density and temperature. The moderate temperature of the nominally acidic bath makes the stopping-off possible by using easy-to-work and low cost wax.

Following plating, the parts are rinsed, the wax removed by hot water treatment and then they are dipped in a bath of protective oil. Edges of the plated areas and necessary radii (as in 2-cycle cylinder liners at both ends and at the ports) are ground to proper shape and the operation is completed.

FACILITIES for these operations are located in a new plant in Olean, New York, handy to all forms of transportation and to all utilities. The layout was made with production line operation in mind.

The 500-ft. line is arranged in a long "U" shape starting and ending at a loading and unloading dock. The first half of the line is devoted to preparation and the second half to plating and finishing.

In addition to the necessary machinery there are 14 tanks for the various dips, rinses, plating, etc., and another is being installed to increase production. They are built of iron with Koroseal linings to protect them from the acid or alkaline baths. Gas heat with provision for conversion to oil is used to heat the tank contents and motor stirrers maintain temperature uniformity within the solution.

Materials handling has received attention and all work is safely and conveniently lifted and transported. The entire work floor is served by an overhead traveling crane augmented by three jib cranes.

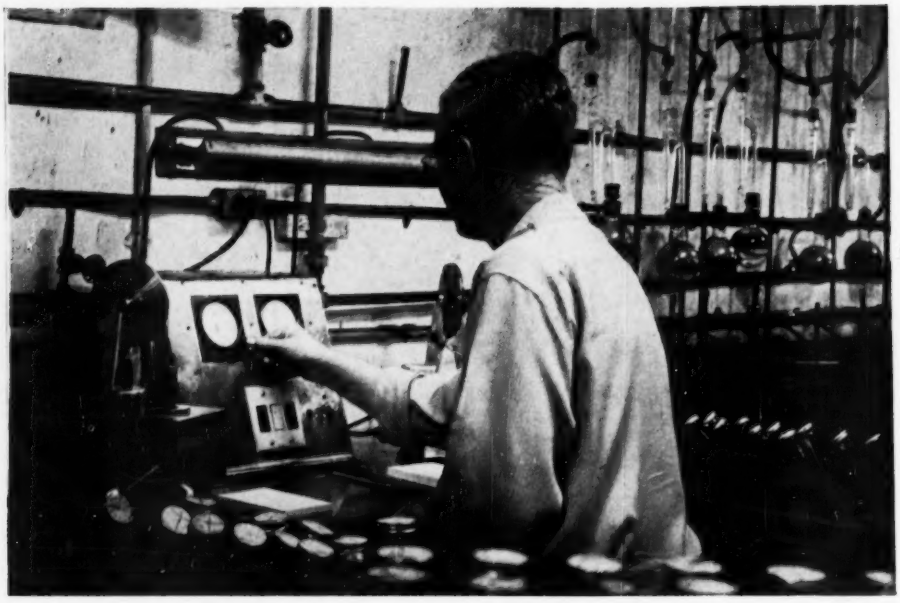
In addition to the facilities at Olean, the capacity of the Spar-Tan Engineering Company, a Los Angeles licensee, is being doubled to handle similar parts restoration. Other facilities are in prospect, in line with the growing scope of the process.

"I can't understand it—after only 79,652 hours continuous service—poof!—she ups and quits!"

SUMMARIZING, this new process offers a valuable service—the possibility of reclamation of badly worn cylinder liners and other parts. Economically it is attractive and should be an important factor in reducing the operational and maintenance costs of diesel engines. As this is one of the most vulnerable spots attacked by advocates of competitive forms of power, any such reduction in costs should reflect to the credit of the entire industry and result in wider diesel application.

The rebuilt wearing surfaces show promise of equaling if not bettering the wearing qualities of the original surface. In addition to offering excellent wear surfaces by itself, the process provides a bridge between extreme conditions of wear and the limitations in thickness of chrome plating, widening the application of the latter. Such surfaces can be built up to size and then chrome plated if desired.

Finally, the potential saving in manhours, production capacity and critical materials is particularly important at this time. Engine builders could concentrate more fully on new engine construction to supply the expanding power needs of both our military and civilian economy.



Running a series of samples through the Faber Viscosity test to determine the extent of fuel dilution or thickening due to contaminants or oil-breakdown products.

Diesel Engine Analyses Through Oil Tests—And What They Prove

by James Joseph
Bureau Chief, Western Round-Up

AN investigation into the use of periodic used crankcase oil analysis was recently run by a national chain of independent testing laboratories who specialize in these analyses. The tests frankly show that oil analysis is not a utopia, but instead is a tool as important as any in the mechanic's kit. The tests resulted in several basic conclusions:

(1) That fuel savings are far more important than oil savings resulting from these tests.

(2) That no mechanic can be expected to determine without laboratory tests, the presence of coke carbon, resin lacquers or abrasives, or whether the viscosity has been thickened by contamination or distillation.

(3) That the only real and practical reasons for engine overhaul is because the engine may fail or has no power, or is using too much oil and fuel and thus is not economical to operate in its present condition.

The laboratory bases these tests and findings upon five months' study of 72 diesel bus engines, in operation in a large U. S. city. Of these 72, all but 26 were eliminated from the final data tabulation because of recent overhauls or because of other factors of a doubtful nature affecting the results. The remaining 26 engines, adjusted after detection of engine troubles through used oil testing, ran 263,027 miles and saved 19,249 gallons of fuel in the process.

Cost of lube oil analyses for the total 72 engines over the five months period amounted to $112.48 per month. The fuel savings chalked up by the 26 engines tabulated, with the analyses being only one of the methods of inspection, amounted to at least $2000 in five months. This savings does not even consider economies from diminished wear and deposit problems, which were reflected in additional dollar savings, although indirectly.

The investigation shows that lube oil analysis, while it has a very definite place in diesel engine operation, particularly vehicular, must be classed along with other important maintenance tools, but from the practical standpoint, cannot be expected to replace all other inspection methods.

"It is true", says this report, "that oil analysis often indicates 'abnormal metal' wear and it is also true that this indication when verified by the mechanics, will often save an engine." These tests prove further that oil analyses do not necessarily relate to the need of overhaul, and that oil conditions may be either good or bad in an engine approaching the overhaul period. Both new and rebuilt engines tested showed good and bad oil conditions. Some engines approaching the over-

Oil samples received in special containers are carefully kept track of as they go through the tests. Here, a sample is poured in crucibles in readiness for the start of testing.

haul period showed metal, some didn't.

"Therefore," summarizes the report, "the value of metal determination is limited to preventing a premature failure and in enabling the mechanics to decide which of several engines to overhaul first."

The weight of responsibility for finding the faults, as indicated by the lube oil tests, rests with the mechanic. "The oil analyses", continues the report, "is only a piece of paper and cannot in itself do anything."

On the basis of these and other investigations, the lab suggests that good maintenance practice demands periodic test bench checks for injectors and fuel distribution components. In addition, and in between test bench checks, oil analysis will indicate the degree of fuel dilution and fuel soot in the engines, enabling the operator to determine injector, fuel distributor and pump efficiency at minimum costs. Oil analyses frequently serve the purpose of checking the installation and operation of replaced injectors to verify their operation prior to the next scheduled test bench check.

It was found also that when mechanics depended upon the color of exhaust in lieu of oil analysis as to ring area condition, damage through deposits and loss of fuel, had already progressed far beyond the point where, had oil analysis been used right along as a maintenance tool, the fault would have been indicated—and could have been corrected at considerable savings.

Used crankcase oil analysis should be taken prior to each mechanical inspection, just as a mechanic would test any component of the engine. The ideal method where possible is to take the oil check one week before each major inspection or at a minor inspection period before the major inspections.

The testing laboratory made no attempt to compute oil savings. These, it considered, are controlled by the extent of fuel dilution, by the ring condition as reflected by deposits, and by normal wear as the engines approach the overhaul period. Time between oil changes is likewise an important factor.

The laboratory, further, does not recommend extending drain periods except upon the advice of the diesel engine manufacturer or oil companies. It has found that so-called savings from extended oil periods are infinitesimal compared to savings in daily oil consumption which may be made by reducing the abnormal conditions which bring about high daily oil consumption.

As an example: doubling oil drain periods in local bus service means one oil change saved approximately every other month. This involves only about 5 or 6 gallons of oil. However, 20 gallons of oil can be saved every month for a bus traveling 4000 miles per month, by the difference of average oil consumption between 30 miles per quart and 60 miles per quart.

"Freedom from engine deposits through oil analyses and use of analyses as a method for revealing fuel combustion trouble between test bench inspections can make the difference", says the report.

Some typical economies, using crankcase oil analysis as a general, practical and routine tool of maintenance are given here.

Bus No.	Before Adjustment		After Adjustment	
	Month	MPG.	Month	MPG.
60	April (adjust valves)	3.9	May	4.9
	June (adjust nozzles)	3.4	June	4.4
			July	4.7
			aver.	4.67

A total of 8716 miles for the period resulted in 630.6 gallons savings in fuel.

Bus No.	Before Adjustment		After Adjustment	
	Month	MPG.	Month	MPG.
50	Dec. (adjust valves)	3.4	Jan.	4.5
			Feb.	3.9
			March	4.3
	March (adjust nozzle)		April	4.5
			May	4.5
			aver.	4.34

This particular bus traveled 12,180 miles during the test period, and as a result of adjustments, predicated upon findings of lube oil analyses, saved 1472.1 gallons of fuel.

A batch of separate samples in the special containers and shipping cartons as received. Instructions are given on when and how to take samples.

Centrifuging is one of the steps in testing. Three separate steps are followed to determine the amounts and types of contaminents in the oil that can best be separated by the use of selected solvents and application of centrifugal force.

All buses were tested in the heaviest kind of traffic, and at peak loads most of the time, which is the reason for the relatively low fuel mileage.

The following is typical of results of oil analyses by the Faber Laboratories who made these investigations. Importance lies in the *change* between tests or, in other words, the system is comparative. "Faber Viscosity", for example, is found by their own production method and while convertible to Kinematic or Saybolt, there is no real need. First figures shown are from a test on May 11 while the second are from a July 18 test.

Bus Number	202
Fuel Dilution	2.0
	4.5
Solids, Volume	0.6
	4.0
Sludge Index	3.0
	14.0
Faber Viscoisty	256
	408
SAE Number	30
	50
Metal	Trace
	.....
Fuel Soot	.....
	High
Overhaul Data	.....
	48,000 miles since last overhaul.

With certain type diesel engines, 7 to 10 per cent fuel dilution is the result of improper combustion: (1) faulty injectors or dribbling, (2) injector push rod not properly adjusted, (3) rack not properly set, (4) poor compression due to valve adjustment, (5) poor compression due to ring seal.

Over 11 per cent fuel dilution usually is the result of a direct fuel leak: (1) loose connections, (2) cracked flanges on injector jumper lines under pressure, (3) cracked fuel oil channel in engine head (not frequent), (4) an extremely bad injector can create more than 11 per cent fuel dilution, but rarely does.

Fuel soot: The presence of high soot indicates need for closer oil filter attention (lack of filterability due to detergency may be the cause); also, a check for air intake restrictions should be made. The difference between fuel soot and fuel dilution is that soot results from improper combustion of fuel while dilution occurs when fuel is not burning at all.

Coke carbon: Coke carbon is formed under piston head and drops into the crankcase oil when abnormally high piston temperature is created because of insufficient cooling due to: clogged radiator, loose fan belts, leaking water system or improper timing. Other causes are: oil piston spray faulty or scale filled radiator.

Sludge index-solids: Sludge index (patented) measures dispersed and "finely divided" oxidized and decomposed oil and fuel products which may be removed by filtration.

This five months' test seems to indicate that, viewed realistically, the used crankcase oil analysis is a tool in the hands of the diesel maintenance mechanic, and should be used that way. But also these tests save time and promote maximum fuel mileage as accurate indicators of injector efficiency.

Do You Need Trained Diesel Men ?

A card to DIESEL POWER AND DIESEL TRANSPORTATION will bring you our listing.

Washington Slant

REPORT ON RECENT MEETING attended in Washington by the Editor holds data of general interest. Key men in three governmental agencies very frankly discussed some of their objectives, progress and problems. Occasion was meeting of the Society of Business Magazine Editors and all stressed the importance of the trade press in furtherance of national objectives. Their comments may explain some of the thinking behind recent Washington decisions.

TELFORD TAYLOR, ADMINISTRATOR, NEW SMALL DEFENSE PLANTS ADMINISTRATION outlined function of infant agency. Held that government procurement is coming in "big bites" now with result that many small businesses are being pinched off as their CMP material supplies dwindle. A focal agency, coordinating efforts of Small Business bureaus in other claimant agencies, its prime function is to help concerns stay in business by getting materials. He emphasized that his is not a contracting agency but assists by (a) recommending loans to RFC, (b) and to see that available materials are equitably distributed.

CHARLES STAUFFACHER, PRINCIPAL ASSISTANT TO C. E. WILSON, reviewed objectives, progress and problems of mobilization program. Major objectives were listed as:

1) Production of military end items for our own use and forces of our allies.
2) Establishment of physical facilities as broad base for production expansion in case of all-out war.
3) Expansion production of basic materials necessary for domestic economy and war production of war materials.
4) Maintenance of greatest possible economic stability both here and abroad.

PEAK DEFENSE PRODUCTION was felt to be reached with quarterly deliveries of 3½ billion of military goods. Held that supposed slowness in contracting was due to misunderstanding of methods of ordering in furtherance of above objectives. Military Procurement is deliberately trying to keep from stocking up on "easy to get" soft goods while going after the "hard to get" military hard goods.

PHYSICAL FACILITIES to provide the broad base feature necessary are being encouraged far beyond the production capacity required for the present mobilization program. The "$50-billion Defense Program" set up at the start was a target rather than a final breakdown of production, further broken down into detailed components. Obviously, it is not being met but plea was made that progress be judged on real accomplishment rather than in relation to a rather "fictitious" target line.

ON CRITICAL MATERIALS, Mr. Stauffacher expressed hope on steel and aluminum, commenting that the first two quarters of 1952 would be the darkest. Copper and the lesser metals were seen as a "long term shortage".

H. H. FOWLER, DEPUTY ADMINISTRATOR, NPA, indicated that the agency would concentrate on minimizing the impact of material shortages upon 1952 economy. One means is closer scheduling. Another is close screening of plans for new facilities expansion, both civilian and military. Some plans are being seen as stretching beyond completion dates in 1953 in to 1954.

SUBSTITUTION, STANDARDIZATION AND SIMPLIFICATION are some of the devices that are to be pushed to stretch available supplies. Scrap program was emphasized. Steel, copper, brass, lead and other metals are vitally needed.

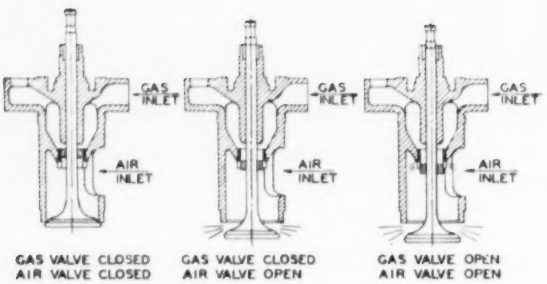
PERSONNEL to man governmental agencies is extremely important. It is in the interest of industry to provide top men for the agencies handling their affairs. Present "tours of duty" last for about six months and competent replacements are necessary. Current NPA releases reflect this: Recent appointments include Arthur J. Kerr to be Director of General Components Division and Otis Howard to be Director of the Engine and Turbine Division.

DECENTRALIZATION OF MATERIALS CONTROL to field offices appears bad for the diesel industry. Many firms because of their materials requirements will automatically fall under field office control. Trouble arises from the personnel angle (see above) and from those operations that cross regional lines. It is obviously difficult to obtain men to head field offices that have intimate knowledge of every industry, its essentiality, and its problems. Where a firm has plants in two regions, separate materials schedules would be necessary and there is no assurance that their consideration would receive judgment based on the same criteria. This could render considerable hardship and increase red tape in the matter of appeals, etc.

High Compression Spark Ignition Gas Engines

by George Steven
Worthington Pump and Machinery Corp., Buffalo, N. Y.

FIG. 1



GAS TIMING VALVE INTEGRAL WITH INLET VALVE SYSTEM

An abstract of the author's address to the Petroleum Mechanical Engineering Conference of the Petroleum Division, A.S.M.E. delivered in September of this year, in which Mr. Steven gives:

- **A generous coverage of background material leading up to the development of the high compression spark ignition engine.**
- **Problems and considerations encountered in the development of this engine along with many examples and test data.**
- **Information on the type of ignition equipment needed with these engines and a comparison of battery and magneto ignition systems.**

In order that we can fully appreciate the evolution of the high compression spark ignition gas engine, it seems necessary to analyze to a degree the history of gas engine development over the past decade.

It is quite certain that early experimenters attempted to raise the compression of spark ignited gas engines, and concluded that it was impractical to operate such an engine at compression pressures materially higher than 120 psig. It is possible that the inability to produce a satisfactory spark with the ignition equipment available at the time was a limitation. Consequently low compression spark ignition gas engines were common until the early 40's.

Ratings on low compression four cycle gas engines were of the order of 70 bmep. with fuel consumption of 9000 to 9500 Btu./bhp./hr. The four-cycle engine is the type of engine dealt with almost exclusively here, since most of our experimental work has been performed on this type.

Beginning of Dual Fuel Engines

During the late 30's research was begun on the gas diesel or dual fuel engine with very gratifying results. With this engine full load diesel ratings could be maintained without preignition or detonation at full diesel compression. Pilot quantity diesel fuel from 5 to 7 per cent was ignited by the compression ignition principle.

About this time supercharging of diesel oil engines became very prominent, so that almost concurrently the problems of gas diesels and supercharged diesel oil engines were being worked on.

The first gas diesel engine that we built was a naturally aspirated unit and made it clear that its success depended on supercharging this engine as well as the diesel oil engine.

A mixing valve was no longer permissible, since gaseous fuel has to be injected into the cylinders at a timed interval after the scavenging period, and due to valve overlap (145-155 deg.) gas would blow through and into the exhaust system.

Methods of Gas Injection

Gas injection into the incoming air stream was necessary. Two arrangements are illustrated here.

The principle most readily adaptable to existing needs was a gas cut off valve on the inlet valve stem. (See Fig. 1.) The inlet cam was also provided with an additional hump so that after the inlet valve had been normally opened at a timed interval of gas injection, the small hump on the cam opened the inlet valve to a greater degree, thereby opening the gas passage permitting flow of gas into the air stream. Mixing problems were solved with the use of diffusers to obtain satisfactory combustion.

Another approach was to provide for a separately cam operated gas injection valve suitably located in the inlet air passageway of the cylinder head. (See Fig. 2.) This construction permitted a longer duration of gas flow, making it possible to inject gas with lower available gas pressure. Again suitable diffusion was necessary for good combustion.

In order to control from the governor the quantity of gas to be supplied for any given load, a separate metering valve was necessary. We first utilized one gas metering valve suitably located in the gas manifold system depending on equal distribution to each cylinder by normal flow means. This arrangement was difficult to control accurately, and we reverted to the use of individual gas metering valves

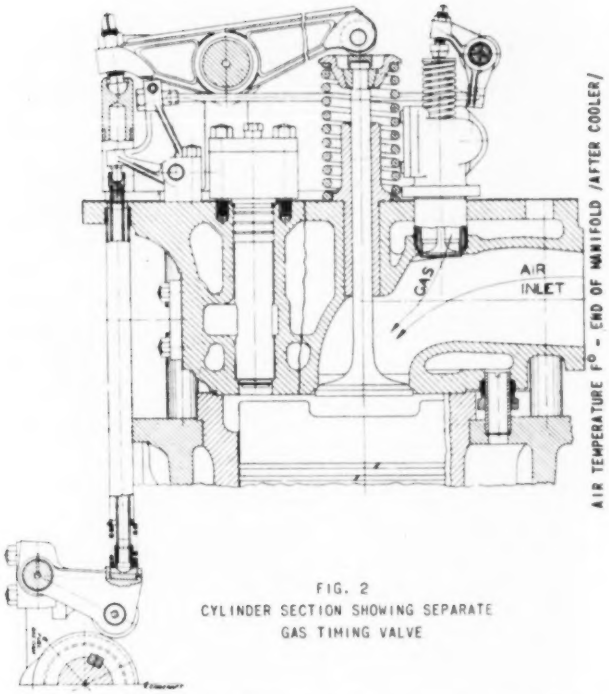


FIG. 2
CYLINDER SECTION SHOWING SEPARATE
GAS TIMING VALVE

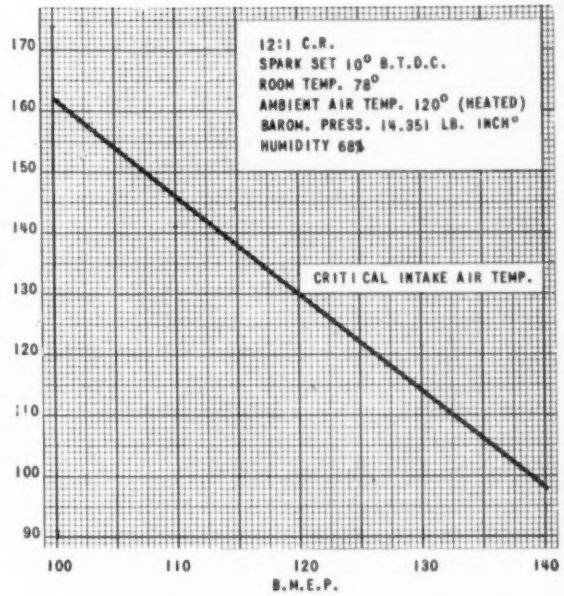


FIG. 3 CRITICAL INTAKE AIR TEMP
BORDERLINE KNOCK PERFORMANCE

for each power cylinder. This made it possible to balance inconsistencies of gas flow through passages which were not always easy to maintain exactly alike. We also found that it was much easier to maintain proper cylinder balance for varying heat values of available gases.

Air-Fuel Considerations

One noticeable difference in the operation of gas diesel engines was the fuel economy at partial loads. While even better fuel economy was obtained at full load with the gas diesel as compared to the diesel oil engine, the reverse was true at partial load operation by a very wide margin.

It became obvious that with the excess air quantities which were available at the partial load conditions, a suitable combustible mixture was not being obtained. It was felt that with a reduction of the air quantity maintaining more nearly air fuel ratio requirements, and eliminating excessive stratification due to lean mixtures, that beneficial results would materialize.

By incorporating in the turbine blower discharge passageway a manually operated damper, the immediate results of throttling the air quantity was a definite improvement in fuel economy at partial load operating conditions. Applying this same degree of throttling to the diesel oil engine had the reverse effect.

Two methods of automatically controlling the air quantity are available. The most obvious arrangement is to suitably connect the damper control to the engine governor, which requires careful design of the damper or throttle valve characteristics, so that with the linear motion produced by the governor, the proper degree of throttling can be producing for each load position. Such a device will not in any way compensate for changes in ambient air temperature. Another approach is to utilize the exhaust stack temperature as a means for controlling the air damper throttle position, taking advantage of the fact that maximum full load exhaust temperature can be maintained without damage to the engine at any other load that may develop as well as full load. We immediately proceeded to develop such a device, which is known as our "thermal-air control system".

Thermal-air control system consists of a thermal element suitably located in the exhaust system and connected through a temperature sensitive instrument to a servo motor operated throttling damper. The problem of designing certain characteristics into the damper are completely eliminated, since regardless of the damper shape, it will always reach its proper position, as called for by the instrument response. This device is also able to correct the degree of throttling for any ambient temperature existing.

While all of the foregoing may lead you to think that the title of this subject is incorrect and that we have been discussing dual fuel engines or gas diesel engines, it is necessary to consider this stage of our development, because it leads directly to the thinking which brought about the development of the high compression spark ignition gas engine.

High Compression Gas Engine Development

Surely, if we could operate a gas engine on high compression by creating ignition with fuel injection, it seemed a natural assumption to believe that the same results should be obtainable with spark ignition provided a suitable ignition system could be made available. The need of high voltage ignition equipment to penetrate the denser media which existed at compression pressures of approximately 450 psi. was demonstrated to manufacturers of ignition equipment.

Coils were developed from which

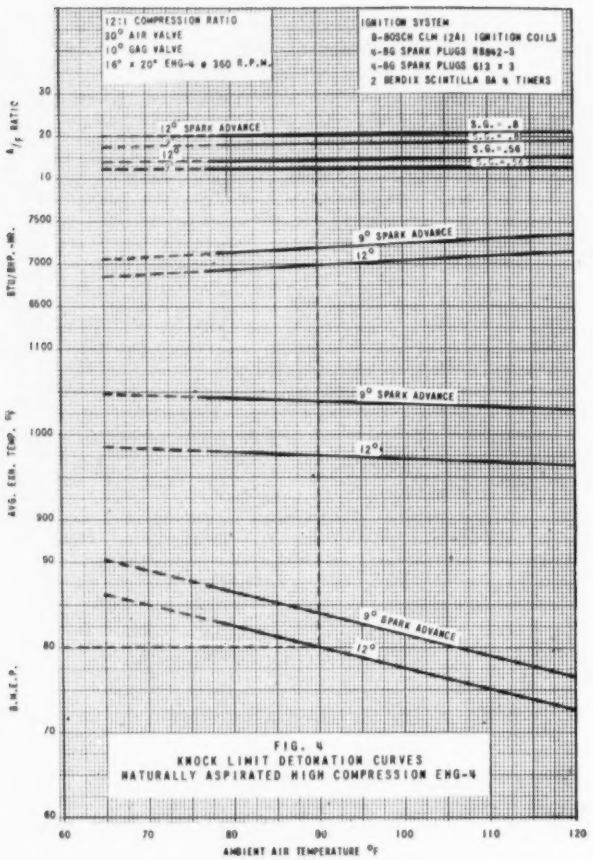


FIG. 4
KNOCK LIMIT DETONATION CURVES
NATURALLY ASPIRATED HIGH COMPRESSION EHG-4

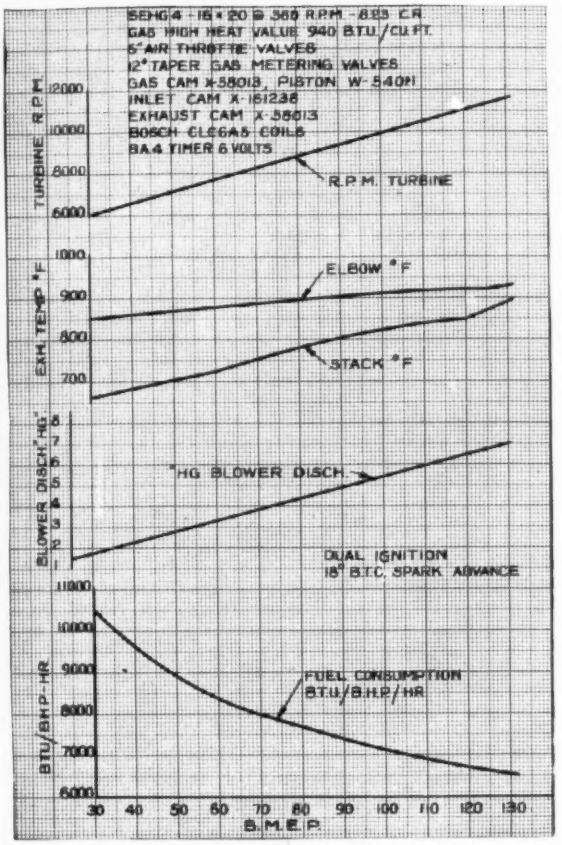


FIG. 5
TURBOCHARGED SPARK IGNITION PERFORMANCE CURVES

battery ignition would produce voltages around 30 kv. With this equipment, it was possible to operate the high compression spark ignition gas engine almost as satisfactorily as a diesel oil engine at full diesel compression with certain limitations.

We discovered that the spark ignition engine required an approximately correct air-gas ratio at all loads to provide a combustible mixture which could be satisfactorily ignited. This is contrary to the requirement of gas diesel engines with pilot oil ignition, which will operate at any load with very lean mixtures, but at the penalty of higher fuel consumption.

As far as we can determine the spark ignition engine will just not operate with these same lean mixtures. Air throttling control is, therefore, a necessity on a high compression spark ignition gas engine, except in naturally aspirated versions where a standard mixing valve can be used.

Again best results were obtained by having an individual air throttling valve for each power cylinder located adjacent to the cylinder head entrance passages, in order that each cylinder obtain the proper air gas ratio mixture and reduce the possibility of cylinder unbalance. No doubt by careful tailoring of manifolds for each cylinder head entrance passage, a single control valve could be made to function, but even with the added expense, it is more satisfactory to use individual gas metering and air control valves.

The bulk of our research has been conducted on a 16 by 20, 4-cycle engine operating at 360 rpm. It has been operated both as a naturally aspirated and supercharged unit.

Being conscious of the problem of detonation, the engine was equipped with an intake air heater by which means the inlet air to the manifold or turbocharger inlet could be elevated to temperatures encountered in service.

Tests were conducted with intake temperatures varying between 90° and 164° F, and it was determined that the detonation limit was reached at lighter loads as the ambient temperature increased. Fig. 3 shows the borderline knock curve between loads of 100 and 140 bmep. and at ambient temperatures previously mentioned.

Using 90° F ambient temperature as DEMA standard rating point, for every 10° higher ambient temperature, it was found that a reduction from 3½ to 5 per cent in load was necessary to limit detonation, depending upon cylinder bore size. Larger bore cylinders are susceptible to somewhat higher deration than the smaller bore cylinders in view of the fact that the cooling jacket effect on larger bore cylinders is less than on smaller ones.

On a supercharged engine it is possible to overcome, to some degree, this difficulty, by aftercooling the turbocharger discharged air.

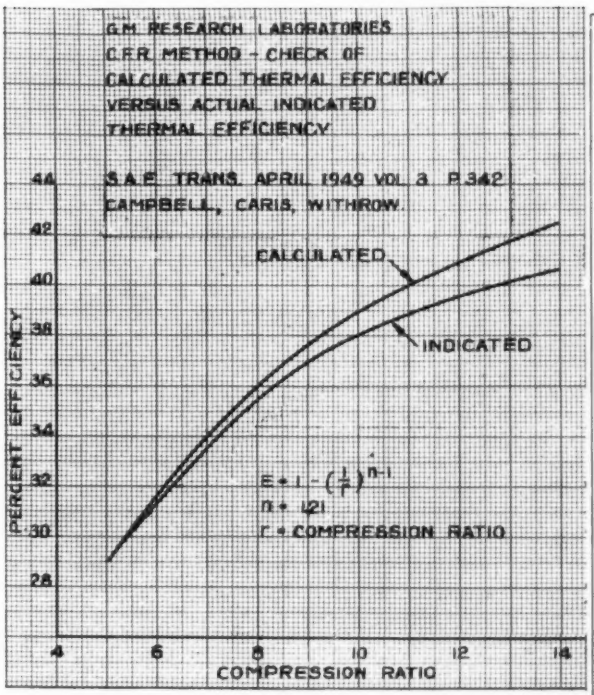
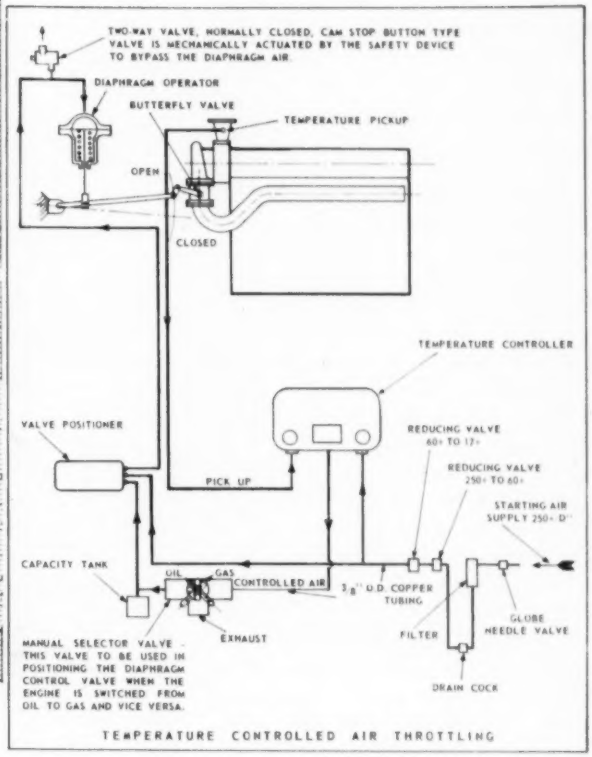


FIG. 6


TWO-WAY VALVE, NORMALLY CLOSED, CAM STOP BUTTON TYPE VALVE IS MECHANICALLY ACTUATED BY THE SAFETY DEVICE TO BYPASS THE DIAPHRAGM AIR
DIAPHRAGM OPERATOR
BUTTERFLY VALVE
TEMPERATURE PICKUP
OPEN
CLOSED
TEMPERATURE CONTROLLER
VALVE POSITIONER
REDUCING VALVE 60+ TO 17+
REDUCING VALVE 250+ TO 60+
PICK UP
STARTING AIR SUPPLY 250+ D
CAPACITY TANK
OIL
GAS
CONTROLLED AIR
3/8" O.D. COPPER TUBING
FILTER
GLOBE NEEDLE VALVE
EXHAUST
DRAIN COCK
MANUAL SELECTOR VALVE - THIS VALVE TO BE USED IN POSITIONING THE DIAPHRAGM CONTROL VALVE WHEN THE ENGINE IS SWITCHED FROM OIL TO GAS AND VICE VERSA.
TEMPERATURE CONTROLLED AIR THROTTLING

The degree of improvement depends upon the temperature of available cooling water, although even 90° F water can be utilized with a properly designed intercooler to produce very good results. Fig. 4 shows the effect of engine rating with relation to ambient temperature and spark advance. Retarding spark, of course, has an adverse effect on exhaust temperature and fuel consumption, both of which are also indicated on Fig. 4, which covers a naturally aspirated operation, but the results are comparable on supercharged operation.

Full load fuel consumptions of 6400 Btu./bhp./hr. on a supercharged engine rated 120 bmep. and using 12:1 compression ratio, has been obtained. This value is a research test value, but 6300 Btu./bhp./hr. is practical for normal operation.

It is my opinion, however, that in an engine, which will never have to operate on any fuel other than gas and where spark ignition is desired, there is considerable merit to adjusting our ideas of compression ratio to a somewhat lower value.

A value of 10:1 in place of 12:1 will provide an engine with less susceptibility to detonation, therefore, being able to carry higher loads without intercooling and the fuel consumption, while not as good, will not suffer too badly. A few comparisons and examples will help in this regard. A 9 by 10½ naturally aspirated gas engine has been in operation for 12 years with 10:1 compression ratio. This unit is similar in all respects to the low compression engine of 5.5 compression ratio except for the use of turbulence type pistons. A high tension magneto with aircraft type spark plugs was incorporated. This unit showed a fuel consumption of 7500 Btu./bhp./hr. A number of 12¼ by 14½ engines have been built with 10:1 compression ratio showing of about 7500 Btu./bhp./hr. with ratings increased from 75 to 80 bmep.

Tests on the 16 by 20, 4-cycle supercharged engine, previously referred to, were conducted with 8.23 compression ratio. Load tests were carried to as high as 145 bmep. without detonation and without the use of an intercooler. The ambient temperatures during this test were 80° F to 90° F. Fig. 5 shows the characteristic performance of this unit from which you will note the fuel consumption of 6700 Btu./bhp./hr. at 120 bmep.

This compares with the previously mentioned fuel consumption of 6400 Btu./bhp./hr. with 12:1 compression ratio, but with the use of intercooling to obtain 120 bmep. Fig. 6 indicates the expected gain in efficiency by increase of compression ratio, and you will note that as we go up higher in compression the indicated results flatten off so that economy improvement becomes less effective.

As a result of the higher compression temperatures which develop, the engine becomes more susceptible to detonation and somewhat more critical for the average operator to handle, unless it is suitably intercooled.

In 1948 an 8½ by 13, 2-cycle exhaust valve in head diesel engine was converted to operation as a spark ignition gas engine. The compression ratio was 14:1. The unit operated successfully, although the load was limited due to the magnitude of the compression ratio. New spacer pieces were installed and compression ratio was reduced to a value of 8:1 under which conditions we were able to carry 110 bmep. without detonation.

On the basis of this research, a larger engine of 16-in. bore and 16-in. stroke operating at 320 rpm. was de-

veloped, with exhaust valves in the head and intake ports in the cylinder liner. Scavenging air was supplied by a reciprocating compressor. Compression ratio was 8¼ to 1, resulting in a compression pressure of 265 psi.

The rating was established at 77 bmep., but overloads have been carried for long operating periods on test to as high as 110 bmep.

Considerable gains of performance from the standpoint of load capacity and fuel consumption have also been obtained by higher compression in the conventional loop scavenged 2-cycle design and some low compression units have been changed over in the field with beneficial results.

It should be mentioned that high hydrogen gas with a hydrogen content in excess of 15 per cent will probably require some deration because of the tendency for this type of gas mixture to detonate. It is not within my scope to predict at this moment what deration values may have to be considered under these circumstances.

Ignition Problems and Considerations

It would be well to emphasize at this time the extreme importance of ignition and some of the factors which must be observed with high compression engines.

(1) Shielded spark plugs are desirable to prevent flash-over from the plug to the adjacent conduction materials.

(2) Improved quality high tension ignition cable is necessary due to the high output of the secondary coil.

(3) Heavy duty coils of 30 kv. output with shielded connections are necessary for 10:1 compression ratio or higher.

(4) If battery timers are used they should be equipped with condensers of approximately four times the capacity, or one microfarad, which was used on low compression engines.

(5) If Rectox rectification equipment is used, proper filtering should be provided to insure smooth dc. flow.

(6) Reversing the polarity by suitable switches is desirable for extending the life of timer points when battery or rectified dc. is used.

(7) Consideration of the use of low tension magnetos instead of battery timers for reasons which will be discussed later.

New types of ignition equipment are becoming available in the form of low tension or high tension impulse generators. The low tension impulse generator can be designed to employ breaker points for starting purposes only and will operate satisfactorily at low speeds.

The units are so designed that the breaker system can be disengaged when certain rotative speed is reached from which point on there are no breaker points in operation and no deterioration of same.

Now, a few points regarding the difference of ignition timing accuracy or quality produced by battery timers and low tension magnetos respectively.

With a battery timer ignition system there are factors which apparently are not or have not been too well recognized. It can be shown that current is induced in the secondary coil when the timer points close as well as when they open. The magnitude of induced current at point closing is much smaller because there has not been time for current flow to saturate the coil.

The magnitude of the secondary coil output will depend upon the primary voltages and, of course, the ratio of turns in the secondary to primary coil.

With a battery system the voltage in the primary circuit will always be 12 volts maximum or even less. In a rectifier circuit the voltage will vary and have a peak value of approximately 15 volts.

In the rectified circuit if the point closing coincided with the peak voltage in the primary circuit the maximum secondary induced voltage will develop and by actual measurement will be almost 2½ times that which would develop from a battery system with a 12 volt uniform output. This is a phenomena which might conceivably, under certain conditions, cause ignition to develop far in advance of the expected timing point.

Another factor which must be seriously considered is the oscillatory driving torque, which is usually existent at any take off point on a reciprocating engine, and particularly on angle compressor units where the compressor cylinders have a tremendous influence on the torque characteristic. Unless the battery timer is equipped with a satisfactory anti-roll back feature, it is possible for the breaker points to reopen immediately after closing which can also produce a highly advanced spark and of greater magnitude than that which might develop from the previously discussed principle.

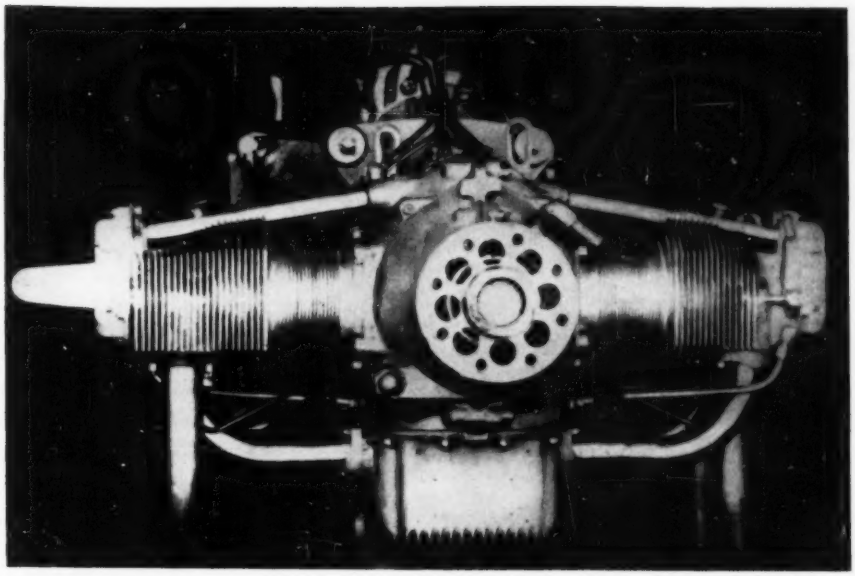
A magneto is quite different in its characteristic of operation since two events must take place in order to produce a spark.

(1) The rotor must be leaving the pole windings and for maximum flux must be at a very particular point in its rotation within very close limits.

(2) Within the range of maximum flux the breaker points have to open so that a rapid rate of change of flux will produce induction in the secondary coil sufficient to produce a spark.

For this reason therefore, in my opinion a properly designed magneto is more accurate in its timing functioning and less susceptible to mechanical disturbances than is the case with battery timers.

The whole subject of ignition is too comprehensive to cover fully in this text. The subject would provide an extremely interesting and timely paper, which I hope some ignition expert will take the trouble to prepare and deliver in the not too distant future.



Front view of the new Diesel Power aircraft engine. Developing 100 hp. at 2400 rpm., the engine is no heavier than its gasoline counterpart. Engine was extensively tested at the California Institute of Technology.

Personal Type Plane Diesel Powered

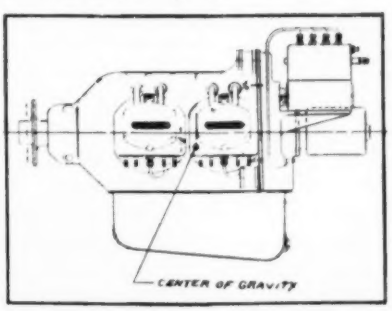
Recently a Taylorcraft airplane made a flight over the Ohio River valley. There is nothing unusual about this except that this plane was powered with a diesel engine no heavier than its gasoline engine counterpart.

This interesting engine was designed by Fred A. Thaheld and built by Diesel Power, Inc. The engine was made from a rebuilt gasoline aircooled aircraft engine on which the original cylinder heads were replaced by aluminum heads with a specially designed combustion chamber and fuel injectors which were threaded and shrunk onto the steel cylinder barrels. Magnetos, ignition wiring, spark plugs, carburetor, and fuel pump of the gasoline engine were discarded and the compression ratio was raised from 7 to 1 to 14 to 1 and in some instances as high as 16 to 1 with no damaging consequences.

Tests on the engine were conducted at the California Institute of Technology to prove the soundness of the engine. Tests with an oscilloscope indicated that the compression end-pressure is of the same order of magnitude as the firing pressure. This is accomplished by means of the specially designed combustion chamber and fuel injection which adds a series of further rapid power pulsations or "explosions" to each single power stroke, thereby giving a lower initial firing pressure. For this reason it is possible to operate this engine at twice the compression ratio that is used by gasoline and spark ignition engines. Injection pressure on the engine is 1500 psi.

Diesel engines applied to aircraft offer several important advantages over conventional gasoline spark ignition engines. First of all, the range of the plane is greatly increased due to lower fuel consumption rates. This means that more payload can be transported a specific distance (by reducing the amount of fuel carried) or the normal payload carried a greater distance with the same tank capacity as provided for a gasoline engine. Secondly, fuel for the diesel engine costs less than half that of the gasoline engine which is specially fond of expensive high octane-fuel. Thirdly, diesel fuels present less of a fire hazard than the highly volatile gasoline. An incidental advantage is the freedom from radio interference and the complications of compression by eliminating the ignition system.

Side view sketch of aircraft diesel showing location of injection pumps.



Operationally, the diesel also has advantages. Diesels will retain a greater percentage of their sea-level horsepower ratings with increasing altitudes. This is due to the larger amounts of excess air available for complete combustion at the lower air weights or densities. The diesel will have a sea level air/fuel ratio of the order of 30 to 1 as compared to 15 to 1 for gasoline burning counterparts.

This factor will be evidenced as increased rpm's. as torque requirements drop off in the rarefied air. Depending on the type of propeller, this can be utilized by increasing the pitch and holding to desired maximum rpm. or used directly on fixed-pitch propellers. Both should result in greater speed. Alternatively and particularly in the latter case, throttle settings could be reduced to cut fuel consumption rates.

Also, since there is no carburetor and fuel vaporizing system on the diesel engine, carburetor icing is eliminated.

DIESEL BRIEFS

Detroit Diesel Puts Ninth Mobile Training Unit on Road

On-the-job training in the operation and maintenance of diesel engines, offered by the Detroit Diesel Engine Division of General Motors, has now been made available to diesel owners and operators in practically all parts of the North American Continent.

The newest addition to the fleet of mobile training schools originally sponsored by the Division has just been dispatched to its first assignment near Alberta, Canada. Another unit recently installed in Mexico is ready to start training diesel men south of the border. These new additions bring the total number of mobile diesel training schools operated by General Motors to a total of nine units.

T. L. Guarniere, service training director of Detroit Diesel, said owners and mechanics in the United States have been quick to realize the advantages of this practical diesel training and over 10,000 men in the construction, lumbering, mining, fishing and petroleum fields have already attended the schools. Similar training in the Trucking Industry is provided by General Motors Truck Division.

DEMA Emphasizes Design Work

Emphasis on design work rather than on research or sales was one of the major recommendations emerging from a recent meeting of the Diesel Engine Manufacturers Association, which was attended by representatives of the industry and by a large group of engineering department faculty men from western colleges and universities.

One of the highlights of the agenda was a post-luncheon address by Otto H. Fischer, president of Union Diesel Engine Company, who dealt with "Engineering Challenges in the Diesel Engine Industry". The question of operating problems in the field was taken up by a panel headed by J. H. Caldwell, service engineer for the Cooper-Bessemer Corporation.

There were two talks on filtration—one by John H. Sheusner of the Enterprise division of General Metals Corporation and the other by John J. Meyer of Winslow Engineering Company. From their divergent points of view, both men agreed on the desirability of full-flow filtration for lubricating oils and on the need for proper filtering of fuels.

The "back to the drawing board" recommendation was an outgrowth of a panel discussion led by Professor C. J. Vogt, of the University of California. In addition to the emphasis on design work, the other four recommendations were: efforts should be made to keep graduate engineers active in engineering; closer cooperation between the industry and the engineering schools; manufacturers should set up scholarships and should make a regular practice of employing students during vacation periods; and all members of the industry should supply pertinent topics to the schools for use in thesis work.

Armed Forces Standardize Engine Parts

Standardization of high-mortality gasoline engine parts used by Army, Navy and Air Force, a program commenced four years ago, will soon near completion. First survey of 149 firms producing engines in 2⅞ to 4⅛ in. bore range showed 138 different models with 15 different cylinder diameters, 1187 different high mortality parts. These 15 bore sizes have been reduced to 5 sizes in 3 to 4 in. range, and further study indicates that number of high mortality parts can be reduced to 63. Program will be expanded to cover larger bore sizes in both gasoline and diesel engines. Munitions Board and Corps of Engineers will soon invite all engine and parts manufacturers to a meeting at which implementation to the program will be explained.

Cutaway Diesel Exhibited

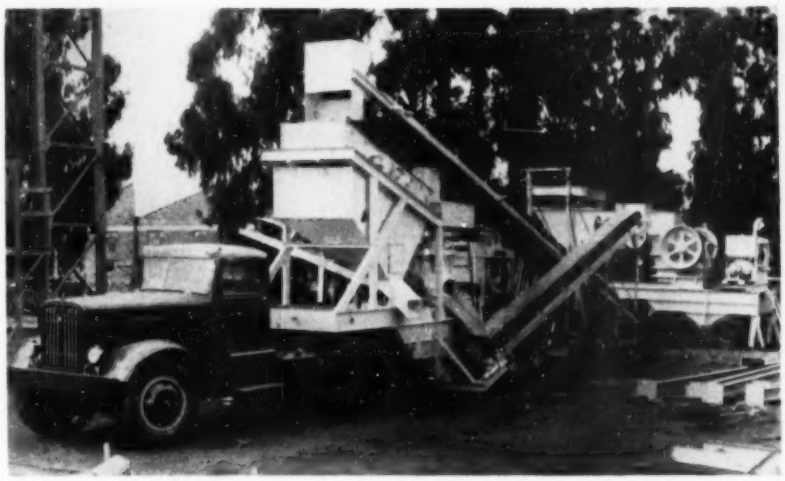
A full size B unit diesel-electric locomotive was exhibited at the Milwaukee station of the Milwaukee Railroad recently.

The locomotive was built by the Electro-Motive Division of General Motors and is similar to the ones used by the road for hauling freight and passenger trains. The engine is cutaway so that it can be inspected from

DIESEL BRIEFS

the outside as well as inside. Especially informative from the public's point of view is the method in which the various systems of the engine are demonstrated. Fuel oil, lubricating, and cooling systems are shown in different colors and are easily followed. An arrangement of mirrors and lights show the action of the injector valves. Also, a large portion of the engine covering has been removed, making it possible to see the movement of the pistons, connecting rods, etc.

The exhibition has proven popular in the area and has attracted hundreds of visitors.



Portable Crushing Plant Diesel Powered

Destined for use in the Transvall area of South Africa, this diesel powered mobile crushing plant was designed and manufactured by W. S. Thomas & Taylor, Ltd., Johannesburg, South Africa. The unit has a feed hopper with a Grizzley 36-in. by 15-in. roller bearing jaw crusher powered by a 150-hp. Model HP-601 Cummins diesel and a 25s Gyratory crusher with a 10-in. by 4-in. two deck vibrating screen and retractable and portable conveyors, powered by a 200-hp. Model HPS-601 Cummins diesel. The engine in the Autocar tractor is 165-hp. Model HRB-600 Cummins diesel.

Machine Tools for Defense Contractors

Ten thousand machine tools held in reserve by the Navy will now be made available to Army and Air Force contractors. Last of a stock of over 40,000 tools held by Navy in mid-50, the machines have been through a mothballing process, including cleaning, repair and replacement of worn or broken parts. About 5000 of original stock has already been turned over to Army and Air Force for defense contractors, some 16,000 are in use on Navy or joint Navy-Air Force contracts. Defense contractors should apply direct to their own contracting agencies to obtain tools released from Navy stores.

Navy Testing Compound To Improve Diesel Fuel

The Navy is testing a new chemical compound designed to raise the quality of diesel fuel to Navy requirements without the refining now necessary, it was announced recently. If successful, it will greatly increase the amount of fuel oil available for submarines and other diesel vessels without added strain on the nation's oil refineries.

The compound is the result of four years of research by the Ethyl Corporation, and is a blend of several amyl nitrates found to be the most economical and practical as a quality booster of diesel fuel. Small amounts of the blend added to diesel fuel will improve its quality, causing it to ignite more readily in the combustion chamber of an engine.

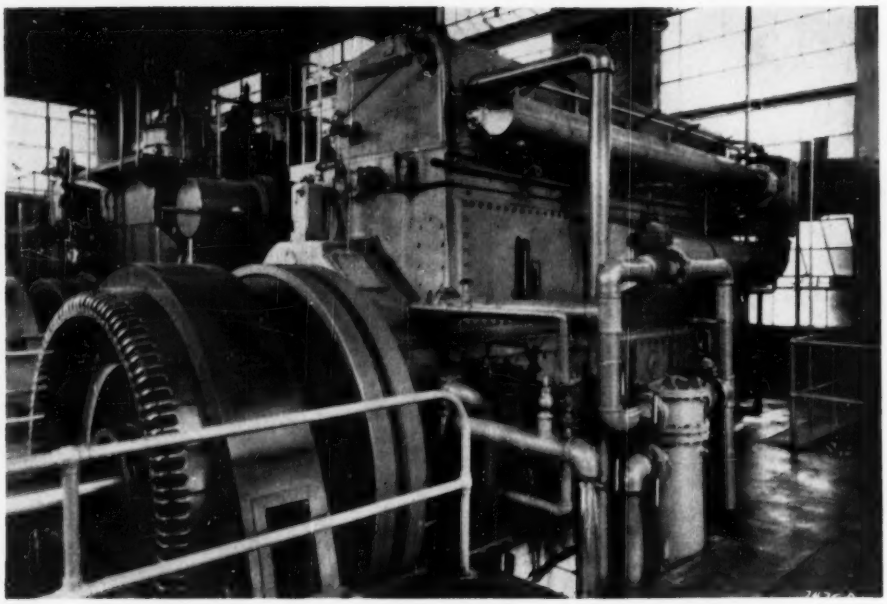
Diesel fuel quality is now raised to Navy specifications by refining, which reduces the amount of usable fuel that can be obtained from a given quantity of crude oil. With use of the new blend, much of this refining might be eliminated which would permit refiners to meet enlarged wartime demands. It would also permit them to devote more of their facilities to production of other critically needed fuels.

Also foreseen is the possibility that diesel manufacturers will be able to design engines to operate on a uniform grade of fuel from coast to coast, instead of on the broad range of fuels now being produced, and thus insure better engine performance. This may be possible because the new compound, when added in different amounts to fuels of different grades, could raise them all to a uniform level.

More Diesels for Great Northern

Purchase of 47 new diesel-electric locomotive units costing an estimated $8,150,000 was authorized by the Great Northern Railway Company board of directors meeting in New York City recently.

The units will make up 26 new locomotives, with delivery scheduled for 1952. The locomotives will include 15 of 1500 horsepower for road and switch duty, 7 of 4500 horsepower for freight, 2 of 3000 horsepower for passenger service, 1 of 3000 horsepower for freight and 1 of 6400 horsepower for freight.



Nordberg Duafuel engine installed in 1949, is now carrying 91 per cent of the plant load and saving the town of Fredonia over $1000 per month. Engine is a 6-cyl. 16 by 22, 4-cycle supercharged unit rated at 200 hp. at 327 rpm.

Fredonia, Kansas Plant Saves Money With Duafuel Engine

Nordberg unit carries 91 per cent of load, cuts fuel bill $1000 a month in first full year of operation.

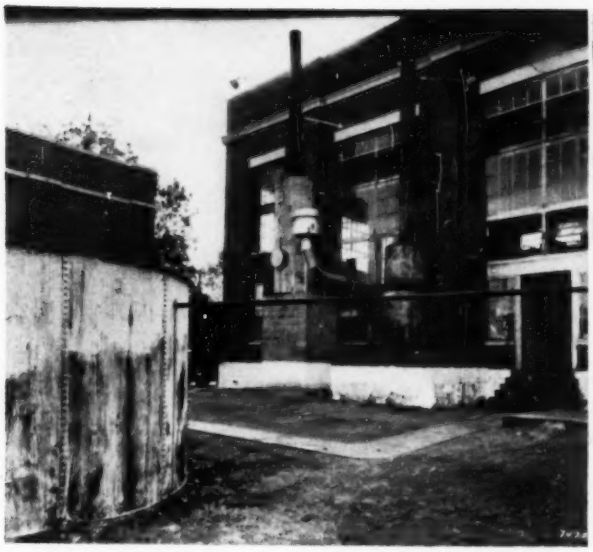
FREDONIA, Kansas has three printing companies that turn out banknotes, bonds and stock certificates, but the town's real moneymaker is a five engine municipal power plant. For more than a quarter of a century, the plant has shown a profit, turning cheap crude oil into electricity which went to residents and industry at rates well below average. Today, a 1200-hp. Nordberg duafuel engine is utilizing natural gas fuel in carrying more than 91 per cent of total plant production. The result is a saving of more than $1000.00 a month as compared with the cost of crude oil.

Fredonia is a thriving community of 4000 population in southeastern Kansas. Besides its dominance in the field of banknote printing, the city has two alfalfa mills, three grain elevators, a large brick manufacturing plant and two locker plants, bringing the industrial power load to 40 per cent of the total. Favorable rates undoubtedly have encouraged business and promoted the expansion of residential consumption. The home user pays just 5 cents for his first kilowatt hour and rates scale down to 2 cents. Charges for the big power user start at 3 cents and go down to 1½ cents.

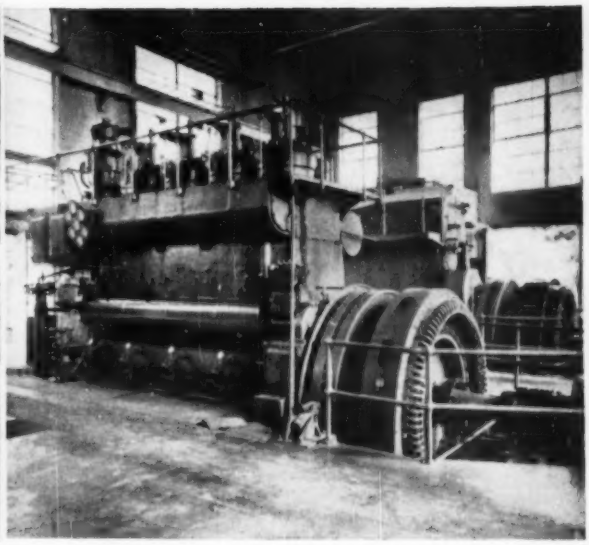
The combination of low rates and consistent profits points to economical power production at the city's plant. Fredonia got its first diesels in 1924, a pair of 300-hp Worthington air-injection engines. Three years later a 600-hp. Worthington engine of the same type was installed. The next addition came in 1931 when the city purchased an 880-hp., 2-cycle, Nordberg air-injection diesel engine. This was the mainstay of the plant for 12 years. Then in October 1949 the city put into service a 6-cyl., 16- by 22-in., 4-cycle Nordberg supercharged duafuel engine rated at 1200-hp. at 327 rpm.

It was recognized that the new engine, with its diet of natural gas and a small quantity of pilot oil, would be substantially cheaper to run than the oil-burning units and a heavy operating schedule was ordered. In the 12-month period ending October 31, 1950, the first full year of operation, the new engine ran 8542 hours out of a possible 8760—actually 97.5 per cent of the time. In that year, the engine generated 4,444,000 kwh. out of a total plant production of 4,878,660 kwh.—91.1 per cent of the total. As of September 21, 1951 the engine has run 15,507 hours with time out for minor adjustments only.

The Nordberg duafuel unit burned 48,812,000 cu. ft. of gas at a cost of $10,333.60 and 27,979 gal. of pilot oil costing $2,448.16. Thus, it took 10.98 cu. ft. of gas and 0.0063 gal. of oil to produce a kwh. In terms of cost, a kwh. took 2.32 mills worth of gas and 0.55 mills worth of oil, a total fuel cost of 2.87 mills. Currently, the engine is doing an even better job. The first months inevitably are a period of adjustment during which the operators learn to get optimum performance from their new equipment. It is significant that in the last six months of the year cited the duafuel engine produced a kilowatt-hour for just 9.87 cu.



Air for the Duafuel engine is received through as Air-Maze oil-bath air filter, and exhaust is through a Maxim exhaust silencer.



Mainstay of the plant before the Duafuel installation was this 880 hp. air injection engine. New Duafuel unit is in background.

ft. of gas and 0.0058 gal. of oil for a total fuel cost of 2.59 mills.

The old air-injection engines burn a crude oil of 24-26 gravity which costs the city 6 cents a gallon. With a production of 11 kwh. per gal. of fuel, the cost per kwh. is 5.45 mills. Comparing this with the duafuel unit, the saving amounts to 2.86 mills per kwh. and $12,709.84 for the same annual production volume.

The crude oil takes a little handling before it can be used in the air-injection engines. It is stored in a 75,000 gal. underground concrete tank and must be raised to 130° F. with a gas heater, then put through a centrifuge and delivered to a 1200 gal. supply tank. Finally, the oil is pumped up to two 400 gal. elevated day tanks in the engine room and flows by gravity through strainers and meters to the four diesels.

Fuel handling for the duafuel engine is virtually automatic. For pilot fuel, the engine uses a 32 gravity diesel oil which is trucked to the plant from a Chanute, Kansas refinery and costs 8.75 cents per gallon. This oil is stored in an 8000 gal. steel tank, is pumped to two 250 gal. elevated day tanks and flows through strainer and meter by gravity to the engine. The natural gas, which has a heating value of 1050 Btu. per cu. ft., comes to the plant at 20 lb. and is metered at that pressure. It then is reduced to 13 lb. and fed to the engine through an admission valve held open by pilot oil pressure. Thus, if pilot oil fails, the gas supply is shut off automatically. On the other hand, if the gas fails, the engine instantly switches over to full diesel operation.

The engine has run satisfactorily with as little as five per cent pilot oil, however a greater safety margin is preferred to insure ignition, and the units run normally with pilot oil supplying seven per cent of the heat energy.

Although a detergent oil is used to lubricate the new engine, a Fuller's earth filter is used for purification. It is felt that this type of filter does the best job and that enough fresh detergent oil is supplied to the cylinders by the cylinder lubricators to provide the benefits of the additive oil. Lubricating oil is drawn from the bottom of the crankcase by a motor-driven pump, put through the purifier, and returned to the crankcase. If necessary, oil can be drained from the engine and put through a batch purifier which removes water dilution as well as the solid impurities. In practice, the gas unit runs clean and has presented no lubrication problems. At this writing, pistons have not been pulled, but crank and main bearings have been inspected and found

(Concluded on page 97)

Principal Equipment of 1220-hp. Nordberg Duafuel

Engine	Nordberg Mfg. Co.
Generator	The Elliott Co.
Turbocharger	Elliott Buchi
Pilot fuel	32 gravity, MFA Refinery
Fuel meter	Xacto
Gas	Union Gas Co.
Gas regulator	Emco
Gas safety valve	Fulton Sylphon Div., Robertshaw Fulton Controls Co.
Governor	Woodward Governor Co.
Fuel filter	W. W. Nugent & Co., Inc.
Cylinder lubricators	Manzel, Inc.
Lubricating oil	DTE 3D, Socony-Vacuum Oil Co.
Lube oil filter	Hanan-Crane Corp.
Lube oil cooler	Ross Heater & Mfg. Co., Inc.
Lube purifier	Youngstown-Miller Co., Inc.
Jacket water pumps	Aurora Pump Co.
Air filters	Air-Maze Corp.
Silencers	Maxim Silencer Co.
Compressor	Curtis
Switchboard	General Electric Co.
Pyrometer	Alnor, Illinois Testing Laboratories, Inc.
Gauges	Lonergan

Filtration of Fuels and Lubricants

by Charles A. Winslow*

In discussing the subject, the author gives his views, not only on the filtration of lubricating oil, but on a variety of fuels as well. Filtration of crude oil and natural gas is covered and a recommended system for the former is illustrated.

DISCUSSION and description of filters for the purposes of this article will be related to the clarification and purification of lubricating oil, fuel oil and fuel gas. To make a fair evaluation of the efficiency of filters, there must be at the start a sound reasonable basis for comparison and measurement.

In the discussion of filters relating to lubricants used in engines it is assumed that the engines are also equipped with air filters to prevent entry of dust into their induction system, at least to a reasonable degree. There is no sense in endeavoring to provide an engine or its lubricating system with clean lubricant if grit and dust are drawn into the air induction system in an excessive quantity. Therefore, the most important filter that can be placed on an engine is an air filter.

Basic Filter Functions

Certain functions are common to both fuel and lubricant filters, whether the fuel be diesel fuel oil, gasoline or natural gas. First and foremost, the velocity of fluid through the filter is a major consideration. For example, if the only requirements of the filter were to strain out all the solid particles above a relatively large size, the job of the filter would be comparatively easy.

On the other hand, if so-called micronic size particles are to be stopped and retained, then the problem is entirely different. High flow rates, high filtering efficiency and large dirt and contaminant holding capacity become a real challenge to the filter designer.

Wear will result from dirt or corrosive material in the fuel or from contaminants circulated with the lubricant. These contaminants, such as impurities formed in the lubricating oil during use, or impurities present in the fuel, are still common problems to the filter makers.

Considering then solid contaminants first, the particle size to be removed is a major consideration. The removal of fine particles is important only if they are large enough to cause wear and trouble. There is no question of the damage done by particle sizes that will not fit through bearing clearances.

Fine Particle Removal

Assume clouds of black sooty air being gently blown through a forest containing millions of flat leafy surfaces. If the forest were dense enough and long enough, all of the soot would eventually be caught. The action is not mechanical straining but due to the phenomenon wherein small particles readily adhere to a large surface mainly because of the electrical charges between the surfaces.

The same principle applies to any filter, i. e., if the filter surface area is great enough, and the velocity low enough, the interstices of the filter do not have to be on the order of a mechanical strainer where the particles will not fit through the holes of the screening medium.

In the so-called good old days of the rule of thumb, filters were generally considered more or less as mechanical strainers with some means of removing the collected material. Industry, however, with its demand for more efficient filters of all kinds and types, made necessary a more scientific study of ways and means of removing harmful particle sizes of contamination and therefore brought greatly increased efficiency in filters of all types.

In the design of modern filters, the use of multiple small and more efficient units has greatly increased the capacity for high flow rates with smaller units. Consequently the study of the rate of dirt formation, volume of dirt, and the kind and particle size of solid material to be filtered out is increasingly important. The graphs (Figs 1 and 2) are self-explanatory and clearly indicate loads that may be imposed on a filter.

Study of Particle Size

Study of particle size under the electron microscope is now common practice and for the first time a detailed examination is possible.

The particles studied are really small; most of them are invisible to the naked eye. They range from a fifth of a micron to 250 microns in diameter, that is, from about eight millionths to a hundredth of an inch.

In the science of filter design, more practical information is necessary than simply the behaviour of particle sizes or a filter's ability to remove small particles. A most important consideration as far as lubricating oil filters are concerned, is just where to begin and where to leave off in prevention of circulation of particle sizes.

In a previous paper the writer brought out the fact that not only were higher speeds obtained with engines, but also greater bearing pressures were developed, in many cases with

*President, Winslow Engineering Co., Oakland, Calif. Abstracted from a paper by the author presented at the SAE National West Coast Meeting, August 13-15, 1951.

less bearing clearance. Therefore, the subject of dirt in engine bearings brings up the very practical consideration of what size particle is detrimental and what size is of absolutely no consequence.

In still another paper by the writer, the effect of dirt particles trapped and embedded on the soft material of bearing caps is discussed and illustrated. This paper points out that all such particles which are embedded into the soft surfaces of aluminum pistons or into the soft material of bearing caps constitute high spots and heat zones which are forever after grinding off the opposing surfaces. The study of particle size therefore is a very important consideration in the practical problem of good filtration engineering as well as lubrication engineering.

Fig. 3 illustrates the relative difference in particle sizes as measured in thousandths of an inch and microns. The purpose of this particular illustration is to point out that if full-flow filters are used, they must at all times prevent particle sizes larger than the bearing clearances from passing; and second, that if smaller micronic size particles are permitted to circulate with the lubricant, under conditions of cold starting abnormal viscosity, etc., and eventually are caught and trapped, no harm will be done to the bearings. Particles measured in 25 microns or less, for instance, will not at any time have any possible chance of being trapped in bearing clearances in conventional engines.

The particles that do the real harm to bearings are not normally measured in micron size, but rather in tens of thousandths or fractions of an inch. It can be appreciated, therefore, that particle sizes measured in low micron numbers are of no consequence whatever so far as full-flow in-line filters are concerned. The principal duty of these filters is to keep harmful contaminants from the bearings and wearing surfaces.

A most important consideration is the provision in a full-flow in-line filter that it will always pass only filtered oil to the bearings freely enough so that the by-pass around the filter element never opens, thus dumping all collected dirt of every size directly into

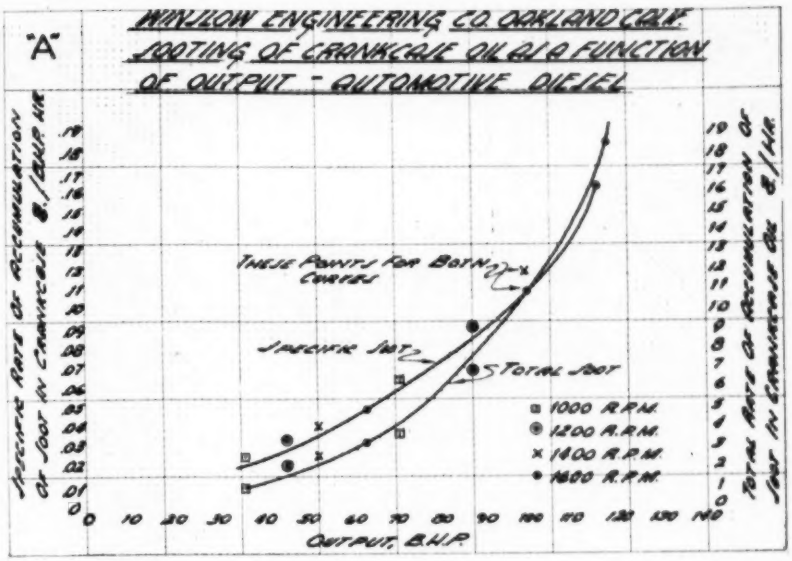
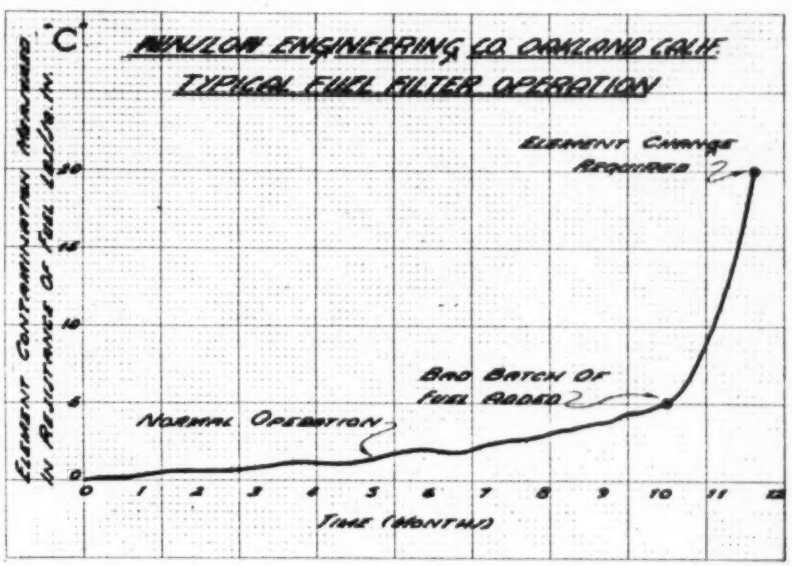

"A"
WINSLOW ENGINEERING CO. OAKLAND CALIF.
LOOTING OF CRANKCASE OIL AS A FUNCTION OF OUTPUT - AUTOMOTIVE DIESEL
SPECIFIC RATE OF ACCUMULATION OF SOOT IN CRANKCASE GR./BHP/HR
TOTAL RATE OF ACCUMULATION OF SOOT IN CRANKCASE GR./HR
THESE POINTS FOR BOTH CURVES
SPECIFIC SOOT
TOTAL SOOT
1000 R.P.M.
1200 R.P.M.
1400 R.P.M.
1600 R.P.M.
OUTPUT, B.H.P.

Fig. 1. Rate of soot formation during normal operation of a conventional truck engine. Rate of soot formation contributes materially to ultimate amount of sludge.

Fig. 2. Illustrating gradual build-up of filter resistance in normal operation with relatively clean fuel and effect of a batch of dirty fuel on filter life.



the bearings. This is exactly what happens when any slow flow rate filter with micronic size interstices sludges over or clogs with dirt.

Thereafter, they are not full-flow, but rather shunt type filters as part or nearly all of the oil passing from the pump to the bearings is being shunted around the filter cartridge or element through the filter bypass.

In the conclusion of this subject as it relates to lubricating oil filters, I might state that, in general, all particle sizes less than the minimum bearing clearances are of small importance, providing they are eventually trapped out of circulation during operation.

Winslow Engineering Approach

As with all engineering, filtering is a compromise as applied to engines, and therefore, a relatively small diameter filter with a relatively high flow rate and a capacity for removing all material in sizes that would be injurious to bearing clearances, is the ideal filter. The dual-flow filter unit shown in Fig. 4 provides one example of this engineering compromise, wherein all detrimental particle sizes are removed

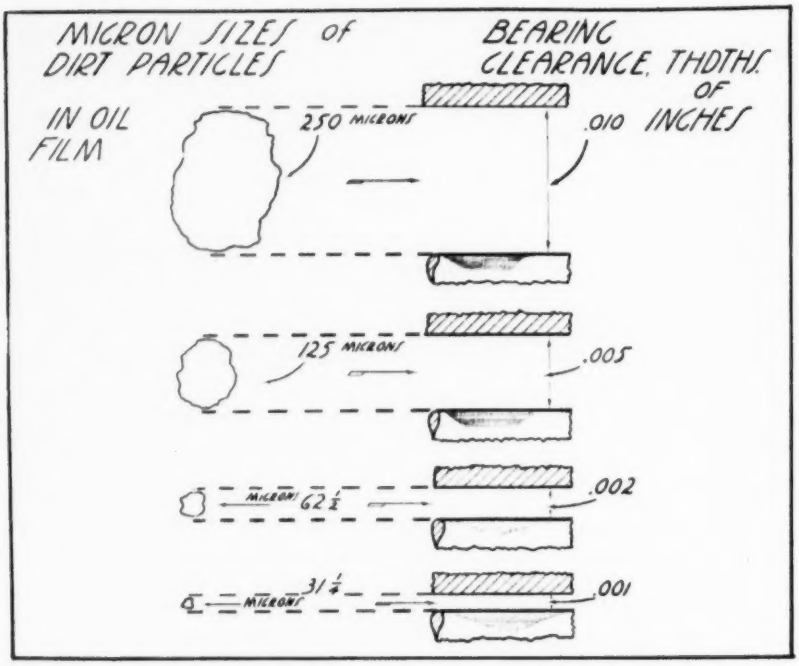


Fig. 3 Relative difference in particle sizes as measured in thousandths of an inch and microns. Particles of 25 microns or less have little chance of being trapped in bearing clearances of conventional engines.

by more or less mechanical straining in the high flow rate section of the filter.

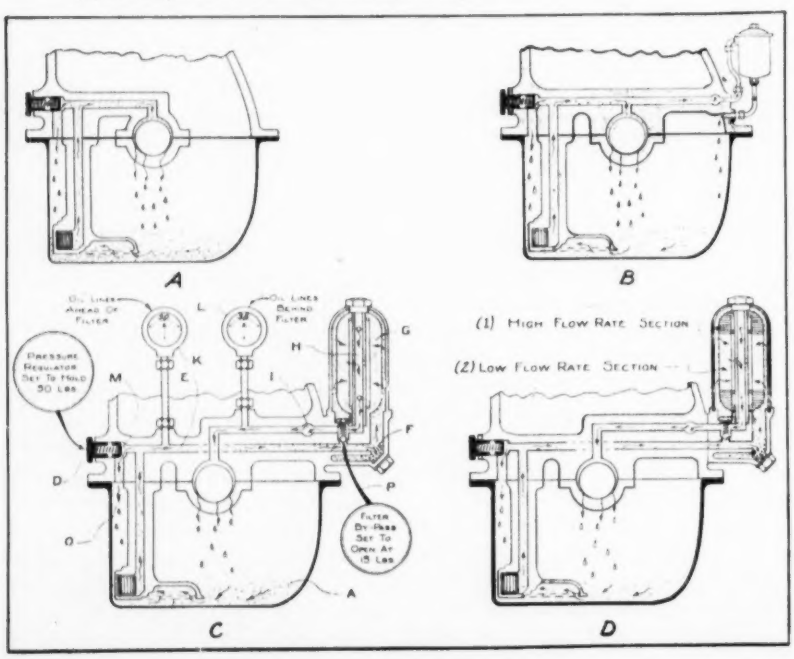
Soot particles and micronic size particles are eventually removed by recirculation through the slow flow rate section by the process best described as adsorption, wherein the particles adhere to the fibres of the filter element material mainly because of the electrical charges between the surfaces.

This process is further aided by other phenomena, including catalytic action and the action of chemicals forming an inherent part of the material used in Winslow lube and fuel oil filters.

In the case of our filters, the filtering is aided by chemical action in much the same manner that a washing machine is aided by the addition of detergents or soap compounds. Secondly, the coalescence of moisture in lubricating oil is aided by other types of chemicals, inert as far as the oil itself is concerned, but always present to aid in this coalescing action and trapping of the moisture. Furthermore, this must all be done without the removal of beneficial compounds which must be permitted to circulate continuously with the lubricant.

Finally, the filter, as we see it, must have an adequate capacity so that the surface type filtration is avoided. The filter cartridge must begin its work by gradually building up dirt at the core and expanding its internal volume with finer particles, moisture, gum, asphaltum, varnish, etc. The exterior portion, and consequently the greatest volume, is then brought into action and finally after being completely filled up, the surface is sludged over and the cartridge is inoperative.

Fig. 4. (A) Illustrates full pressure re-circulating system without filter. (B) Similar system with shunt type filter. (C) Conventional system with full-flow filtration. (D) Same system wih Winslow dual flow filtering.



Fuel Oil Filters

Fuel oil filters present an entirely different problem to the filter designer, inasmuch as particle sizes are important. All deleterious material and particle sizes of any dimension that might be damaging to the injection equipment of the engine must be removed at one pass, since no recirculation generally is provided.

Even though liquid fuels are delivered clean to the fuel tanks, there is no assurance that such fuel will stay clean and free of impurities while in storage. In the normal breathing of the tank, varying air temperatures result in condensation of water.

There is also the possibility of sulphur in the fuel combining with the water, to cause rust and corrosion of the tank. Gums and varnish are also present in many types of fuel, and the settling and coagulation of solid particles, together with the coalescence of moisture, forms a potential hazard in the bottom of most fuel tanks. Fig. 5 illustrates an ideal fuel system.

The large filter, placed at the outlet of the fuel supply tank, will be available to remove and trap any excess of sludge, dirt, water, etc., and thus prevent the passage of foreign material into the day tank or the eventual clogging of the small final-pass duplex filter on the engine. This final duplex filter is provided to prevent pipe scale, thread chips, gasket particles, etc., from pipe lines or fittings, from entering the injection equipment on the engine.

Regarding the design of the cartridge for fuel filters, the same general problem of filter capacity as related to size and efficiency is a major consideration. All dirt must be removed at one pass.

An ideal type of fuel filtering media is one in which the majority of the coarse particles are retained on the outer surfaces and the gradual collection of smaller particles is obtained throughout the mixture of the filter media until finally, near the core, an absolute stoppage of any particle size detrimental to the injection system is provided with a filtering medium of a known porosity. In this way, a greatly increased filter capacity is provided.

Filtering Crude Oil

Up to here, conventional fuels have been under consideration. However, new and more efficient filters have been designed making it possible to use raw fuels direct from the ground in either gas or diesel engines.

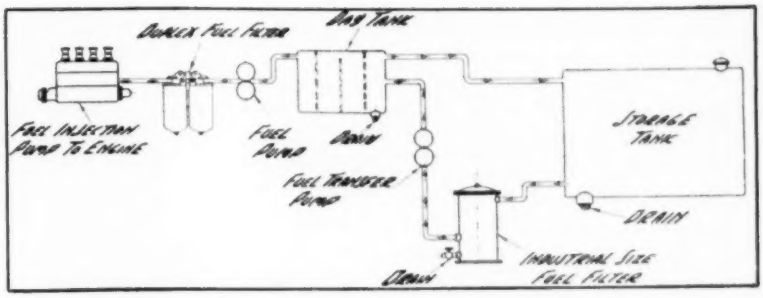


Fig. 5 An efficient fuel system including pump for continual circulation of fuel through large primary filter.

Attention is called to a system shown in Fig. 6 that has been designed and built by the writer's firm and operated in various oil fields for the past several years. It is not claimed that this system is a replacement for an oil refinery. It is claimed, however, and clearly demonstrated over a considerable time, that the fuel is cleaned of all detrimental material which might affect the successful, practical and economical operation of the engine.

The patented construction of the cartridges in the primary and secondary filters makes possible the inclusion of materials in the cartridges which do more than simply filter the crude. They take advantage of catalytic action on certain types of harmful materials which are present and must be removed, and provide chemical action on other types of contaminants which must also be removed.

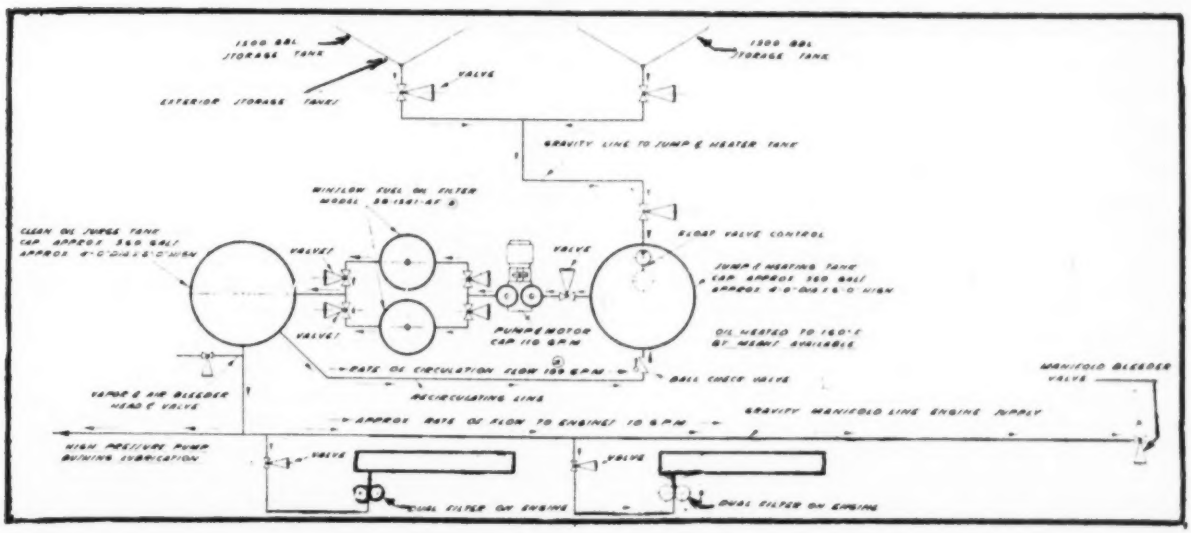
This is not a simple straining process. It provides means for the coagulation of microscopic, practically unfilterable particles into forms which are filterable and; coalescence of unfilterable moisture into particles sizes that do become filterable in the recirculating process.

Filtering Natural Gas

Where raw natural gas from the pipelines is used for fuel, considerable corrosive material is sometimes encountered. Filtering gaseous fuels at low pressure is relatively easy. Deleterious material such as solids, gums, highly corrosive moisture, etc., are simple to remove from the gaseous fuel, providing, however, that low velocity and relatively large filtering areas are used. Low differential filtering pressure is generally a must.

Large filtering units, in outside appearance and construction similar to those previously described for the filtering of lubricants, are used in this

Fig. 6 Crude oil fuel system developed by Winslow and operated in various oil fields for the past several years. Specially treated cartridges are used and a primary recirculating and secondary one-pass system are provided.



case, but with special elements for the coalescence of moisture particles and the coagulation of solids, gums, varnishes, etc., which are to be filtered out of the gas at relatively

First cost is not a criterion of the soundness of investment of such types of filters for the reason that the economies effected are so great that large size units are well justified.

When natural gas in its raw state is used for fuel in engines, it is primarily important that as much harmful substance as possible be taken out by the filters used on the natural gas before it reaches the engine. Any residue not thus trapped which tends to form acid in crankcases will be absorbed by the lube oil filter elements.

Efficacy of filters in removing acidic materials is attested in recent laboratory tests, in this case conducted on oil filter elements from engines operating on sour gas. Samples taken from the outer portion of the two elements had neutralization numbers of 2.00 and 2.54. Results from samples taken near the core were 1.72 and 1.60, respectively.

It should be made clear that just simple filtering of either liquid or gaseous raw fuel and/or lubricating oil in engines using raw fuel is not the answer to the problems that are generated in this type of service. Detrimental substances, primarily in the fuel or secondarily in the lubricant are very severe and require special kinds and types of filters high in filtering efficiency.

Summary

Straining through a paper, a screen or a brush pile, is one form of stopping contaminants. On the other hand, and at the opposite end of the scale of efficiency, is the more scientific method of first, finding out exactly what kind, type and size of filtering equipment is required to do a good job of protecting engine bearings and injection equipment, then properly engineering the installation to the engine or machinery to be protected.

Finally, the installation of scientifically designed filtering equipment insuring against corrosion and abrasion of expensive machinery, is one of the best investments that can be made in reduction of operating and maintenance costs.

Diesel Switcher Cuts Manpower Need

by Dick LaCoste

Down through the years at Westover Air Force Base, eastern hub of the Military Air Transport Service, the base's railroad men waged a continuous battle of extermination against the grass and weeds growing along the five miles of terminal tracks.

Until the Korean hostilities, Westover officials handled the problem in typical military manner. A 10-man detail labored 8 hr. daily for 10 weeks to clear weeds which so slicked the tracks that satisfactory speed was impossible. Annual cost: $7000.

Last summer, to the amazement of Westover people, the disgust of "goldbrickers", and the delight of the diesel engineers, the weeds were well under control.

Instead of the 10-week weed-cutting program the job is now done in 3½ hrs. at a cost of $104. This is how the diesels entered into the picture.

As manpower needs became acute, John J. O'Connor and Walter F. Bradbury, Air Installation employes, decided that 10 men could not be spared to cut weeds that grew almost as fast as cleaned up.

Obviously, the solution was a chemical weed killer. It had had success in other areas at the base. The logical assumption was that it would work along the tracks too. The next question was how to spray it.

Finally, O'Conner latched on the idea of loading the chemical unit on a flat car to be pulled by the base's diesel switcher. The 6 by 6 truck, mounting a 300-gal. tank, was loaded on the flat car and hooked to the 44-ton diesel switch engine.

The 300-hp. switcher, built in 1942 by General Electric, had a speed of 20 mph., but for this job was slowed down to 7 mph. Mission was accomplished 3½ hours later.

In itself, this off-trail story of a diesel is not of earth-shaking importance. It only serves to point out how, with a little ingenuity, machinery can be made to substitute for man-power; here saving about 4000 man-hours figured on a 40-hr. week. There must be thousands of such opportunities and think of the savings in dollars as well as critical man-hours.

Two-Cycle Engine Design Uses Lever Principle

IT is well recognized that the power and efficiency of 2-cycle blower-aspirated diesel engines, particularly of the smaller, higher speed type, is limited by the scavenging efficiency inherent to the design. With this thought in mind, the engineers of Lever Motors Corporation turned to the old principle of the lever in an effort to obtain greater specific horsepower output and better general efficiency.

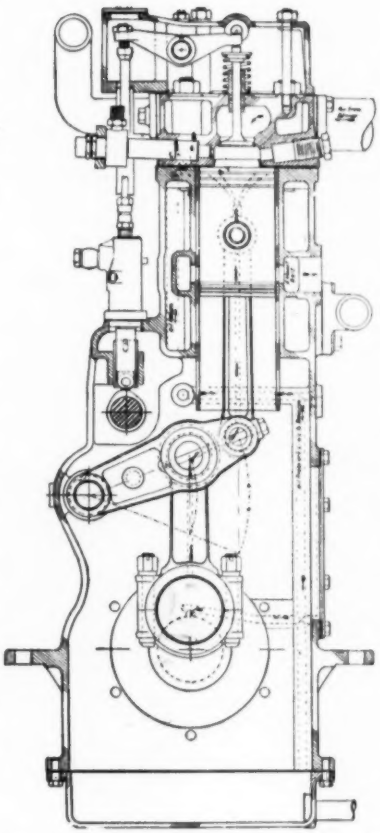
A test engine was built to check the soundness of their ideas. Its conformation is shown in the illustrated cross section. It was felt that definite advantages would accrue through the interposition of the lever between the piston and the crankshaft.

Uniflow scavenging was adopted as the basis for the design due to its potential efficiency. The ability to time one of the scavenging functions independently of the other is a definite advantage. In this case the intake air enters through a valve in the cylinder head while exhaust gases leave through a port belt at the lower portion of the swept area.

Here, the lever principle is used to advantage. The differential action of the second class lever results in a pronounced dwell at the bottom of the stroke which aids the exhaust process. The inlet valve is timed to open just after cylinder pressures have dropped and to remain open after the piston has closed the exhaust ports. The incoming air cools the parts subjected to maximum heat.

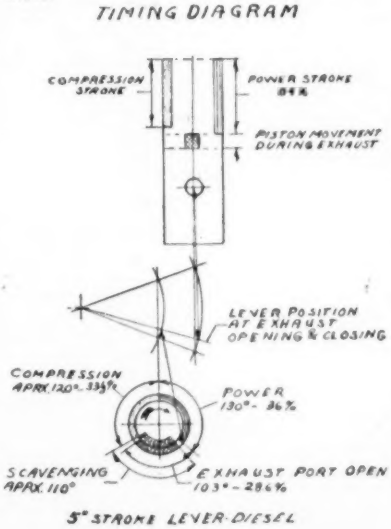
It can be seen that the power stroke is longer than would be possible in the case of a conventional loop scavenged engine and slightly longer than in the case of a uniflow system in which the exhaust was in the cylinder head. Here, it is necessary to open the exhaust valve before the piston uncovers the intake ports.

This long follow-through on the power stroke is attributed as a reason for a marked non-stalling characteristic noted in the test engine. Good lugging ability is very much to be desired. Another feature is the high degree of flexibility noted. A possible explanation for this and the non-stalling characteristic is believed to be the movement ratio of the piston to crank as a function of the lever motion. This ratio is approximately 1 to 1 as compared to 1 to 1½ in a comparative conventional type 2-cycle engine. At 1200 rpm. the piston travel is 1000 ft., while crankpin travel is 1040 ft. In the conventional engine the figures are 1000 and 1570, respectively. The shorter radius of the crank in the lever engine accounts for the difference.



Cross section showing the interposition of the lever between the piston and crankshaft.

Diagram demonstrating the longer power stroke and pronounced dwell at the bottom of the stroke.



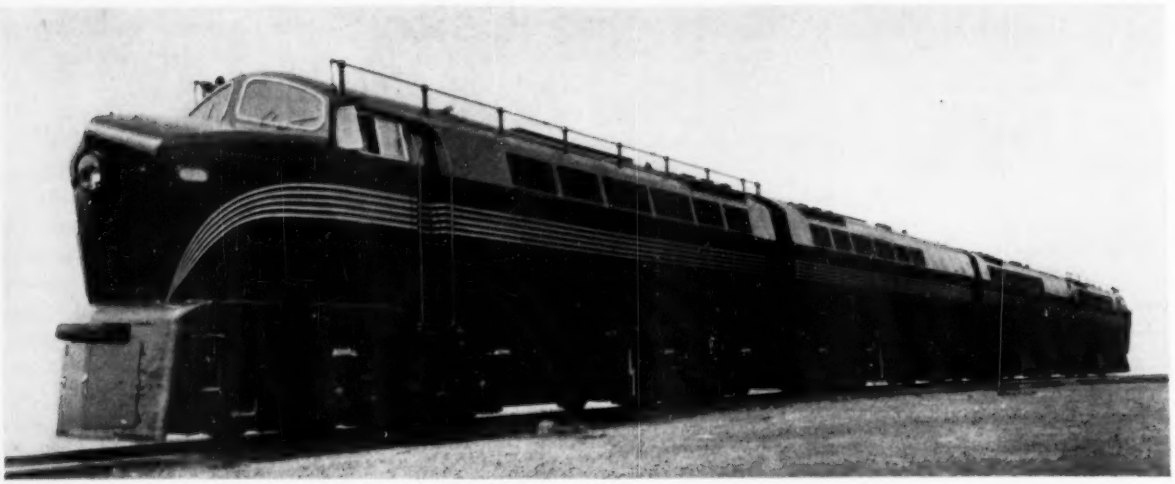
Maximum angularity of the piston rod is only 3.3 deg. off the axis of the bore. This minimizes side thrust of the piston, but is sufficient to eliminate any tendency for the piston to slap. Note also that the upper end of the connecting rod also moves outward in a slight arc. This, in conjunction with the outward movement of the crank makes for more efficient application of power on the crank. A design analysis is reported to show a desirable equalization of bearing pressures throughout the reciprocating mechanism.

Operational Data

Reports on the operation of the test engine indicates some favorable characteristics. Although little refinement has been done on the combustion chamber there has been no evidence of the ping or knock associated with peak pressures. An optimum fuel rate of 0.46 lb. per hr. at approximately 1050 rpm. at about 90 per cent load has been obtained.

Tests on the 2-cyl. model showed that a maximum of 26 hp. was developed at 1500 rpm. Maximum torque of 100 ft. lbs. and maximum bmep. of 25 psi. were produced at 1100 rpm. Appreciable increases in the above

(*Continued on page* 96)



Baldwin-Westinghouse 6400-hp. road freight locomotive.

Notes on preventive measures for avoidance of excessive maintenance on . . . . .

Baldwin Diesel-Electric Locomotives

*by W. J. Thornton**

If the railroads are to find their investment in diesel-electric locomotives fully profitable and desirable, they must have high availability, low operating and maintenance expense, and reasonable repair costs spaced at long intervals. Long field experience has shown that innumerable failures would not have occurred had normal maintenance practices included systematic inspection to detect impending or existing troubles with the necessary prompt corrective action. Some recommendations from one locomotive builder are outlined in this article.

Highlights of the recommended inspection and maintenance procedures are grouped under three headings: Power Plant; Electrical Equipment; and Mechanical. In the more complete and detailed service manuals there is also a Lubrication Schedule and all of the procedures are correlated with some specific time period or with the average mileage equivalent for road power. The purpose of the following is to outline some of the more important items of each general group that are involved in a preventive maintenance program.

Power Plant

Inspection of a power plant which has given consistant average performance, with the intent of making necessary adjustments and repairs to insure continuance of trouble-free operation, is covered under this heading.

Preparation for Inspection—

includes cleaning the engine externally of all loose dirt, examination for oil leaks, then opening up the covers and inspection doors to expose the parts to be inspected. This includes removal of crankcase inspection covers, cylinder head cover lids exposing the valve tappet mechanism, cam box cover for examination of the camshaft, followers and other parts, and inspection hole covers in driving chain cases.

As the crankcase is opened extreme care should be exercised so that no dirt or other particles fall through the openings. The best practice is to locate the covers over the openings loosely at every opportunity while work on other parts of the engine is in progress.

**Condensation of a talk by the author, Field Service Manager, Baldwin-Lima-Hamilton Corp., before the Northwest Locomotive Association, St. Paul, Minn.*

Crankcase Inspection Plate Gaskets—

under the cover plates that are squeezed thin should be renewed whether or not there are indications of oil leaks. This is necessary to avoid seepage of oil and collection of dirt on engine, oily condition of engine room, and to prevent a change in crankcase pressure conditions.

Later when covers are replaced care should be taken to see that gaskets seat properly, that cover brackets are squarely in place and that bracket screws are not tightened excessively.

Oil Samples—

should be taken from the main body of lube oil in the sump as soon as the engine is shut down, either for a "Visgage" check or preferably for an analysis of viscosity, flash point, water and sediment conditions, if laboratory facilities are available. As the "Visgage" reading is used for a comparative check over a period of operating time a complete laboratory analysis is important if there is any doubt as to the satisfactory condition of the oil.

Such an analysis may prevent considerable damage to the engine if action is taken immediately whenever an unsatisfactory condition of oil is found.

In Case of Fuel Oil Dilution—

of the lube oil, the injection system must be examined to discover the leak or other incorrect condition causing it. Oil should *never* be changed and the locomotive allowed to continue in service without the cause of dilution having been found and corrected. Points to check for leaks are: (a) all high pressure lines and drain line connections; (b) fuel pumps at connections and around racks; (c) fuel injector adapters and connections; (d) then if no leaks have been found the injectors should be removed for spray atomization and popping pressure checks. If there is fuel on top of the cam box, check umbrellas on follower tappets and cam follower brackets for tightness.

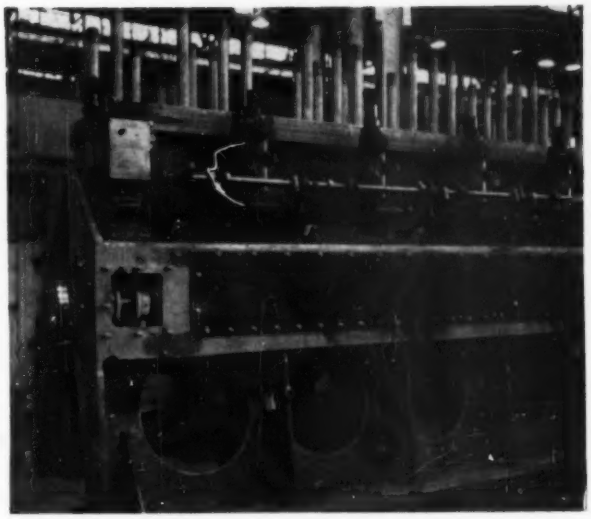
When injection lines are removed, immediately cover discharge openings of the fuel pumps to keep out any trace of dirt that might cause scoring of the barrel and plunger of the injection pump. The same precaution is necessary when an injector is removed. No work should be done over an opening in the cylinder head without plugging of the hole.

Before replacing injectors be sure that all adapters (if not of the spot-welded type) are bench tightened to 250-300 ft. lb. and that the high pressure line connector is tightened in the adapter before the final seating of the injector (at 50 ft. lb. torque) in the cylinder head. Finally, check to make sure that there are no leaks around joints that have been broken.

When changing oil because of dilution or for other reasons the crankcase should be flushed and cleaned out before putting in the new oil.

Parts to Inspect—

when the engine is open include: observing thrust faces



View of engine under construction, showing control rack, cam box cover, and governor drive. Note exceptionally large crankcase inspection holes.

of main and connecting rod bearings (in the latest design of thin wall bearings thrust faces have been eliminated); examining all internal bolting—see if all cotter pins are in place; inspecting lube oil lines from header to main bearings; looking for cylinder seal water leaks; checking tension of all timing and driving chains—total slack should be ¼ in. in lube oil and water pump drives and ¾ in. in timing chains.

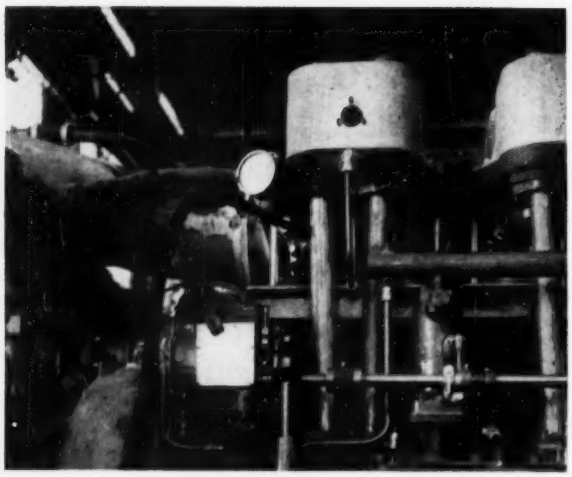
Barring the engine over makes possible (1) viewing of each cylinder bore from lower end for scoring, scuffed areas and cracks; (2) checking the timing of fuel pumps, and also the timing of inlet and exhaust valves for which procedures, specific instructions are given in service manuals along with the recommended intervals between inspections; (3) a check for compression balance among the cylinders. The latter is done by using a shop air line coupling fitted with a gauge connected to the indicator cock of each cylinder in turn, charging to 90 psi., shutting off the air, and noting the bleed-off time.

If an annual inspection is being made, the caps from any two main bearings should be removed and condition of the shells examined. Also, a cylinder head should be removed and a piston pulled for examination of the piston, rings, liner, connecting rod and other parts. At every opportunity and particularly during bearing examinations the crankshaft main bearing journals, crank pins and webbs should be checked for cracks.

In reapplying bearing shells to the caps and the caps to the engine bedplate it is important that both shells and caps are matched and installed in the same relation to each other as previously assembled (match marking of caps to bedplate). After reassembly an alignment check by the crankshaft distortion method should be made.

When replacing heads care is to be exercised so that cylinder head flange faces for intake and exhaust headers are flush and in line.

Inspection of cambox should include all corners and



Air connection to cylinder when testing for compression balance and for checking bearing alignment by distortion method.

pockets to detect the presence of any metal deposits or other foreign material. If any metal particles are found, an examination of camshaft and follower mechanism is most important to locate worn parts or other defects. Appropriate action to remedy improper condition found is imperative.

Tightening of Bolts and Nuts—

during crankcase inspection, if it is at all possible, should be made to correct torqued values, e.g. 500 ft. lb. for main bearing and connecting rod bolts; 50 ft. lb. for nuts holding camshaft trough cover and for nuts holding cylinder head covers.

Exhaust header bolts which are subjected to high temperatures should be protected with an anti-seizing compound applied prior to installation, to facilitate removal. (Molykote by The Alpha Corp., C-S Fel Pro Hi-Temperature Copper Compound, by Surveys, Inc. or equal is recommended).

Fuel Injection Equipment Repairs—

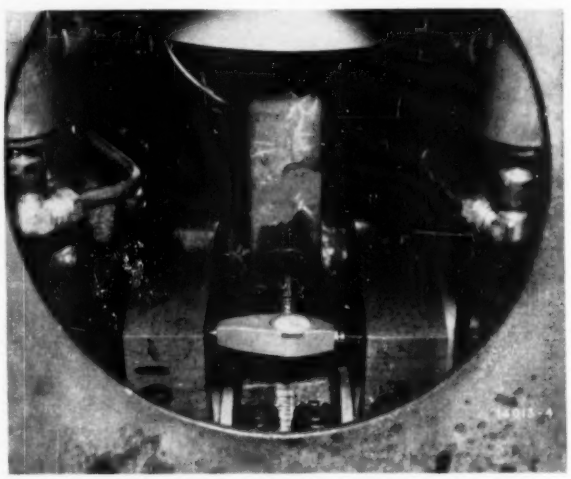
are receiving closer attention as more and more railroads, which do their own maintenance and repairs on injectors and injection pumps, are providing a room completely enclosed to keep out dust and dirt from other parts of the shop for this work. Changeouts are being done in a more orderly and organized manner. While cleanliness is the rule in such rooms, there is still much need for improvement in cleanliness and care in handling parts returned to the builder on the Unit Exchange plan. This is evidenced in many cases of scored pumps and injectors received. The volume of business handled on the Unit Exchange plan for parts needing repairs is growing. It is one solution to fuel injection maintenance at low cost as parts receive expert attention in this way.

Electrical Equipment

Identical switch gear, controls and rotating equipment are used wherever possible in the design and production of the various types of locomotives. This standardization enables the railroads to carry in spare parts stock a larger number of items, thus assisting in a preventive maintenance program—having the part when needed yet with a minimum inventory. The builders' "Repair and Return" and "Unit Exchange" plans tie in with the spare parts and maintenance problems.

Fire Hazard Elimination—

by reducing undue arcing of contactors, and to eliminate oily and dirty conditions in the engine room are exceedingly important and require never ending vigilance. Electrical cabinets should be kept cleaned out, making use of a vacuum cleaner if available, otherwise use shop air at



Checking bearing alignment by the crankshaft distortion method. Inspecion of oil lines, main and connecting rod bolting, and condition of the lower part of the liners can also be made.

about 50 psi. (never use 90 psi.) for blowing dirt out of the cabinets, and the air must not contain moisture.

Protect Electrical Equipment—

when washing or cleaning any part of the locomotive with water or low pressure steam by keeping all doors shut and cover or otherwise guard against moisture getting into electrical equipment, or grounds may result. When a locomotive is run through a wash rack the engine or engines should be operated at part throttle. When hose washing or steaming trucks, traction motor switches should be pulled. Later, engines should be operated at 1/3 or 1/2 throttle to assure dry motors.

Electrical Cabinets and Contained Parts—

should be protected as much as possible. Engine crews and others concerned should be familar with all switches and well instructed as to which ones should not be opened when under power, to guard against excessive arcing. Adjustments in electrical equipment should be made only by qualified personnel.

Electro-pneumatic valves which regulate the operation of various switches should be checked to make sure none

of them are sticking—usually caused by dirt accumulation on spindles and underseats.

Contact tips of switches should be kept free of oxidation for good contact and free passing of current. Filing of tips should not be done; the use of a fine abrasive cloth is recommended, followed by a blowing out of dust.

Commutator Brushes—

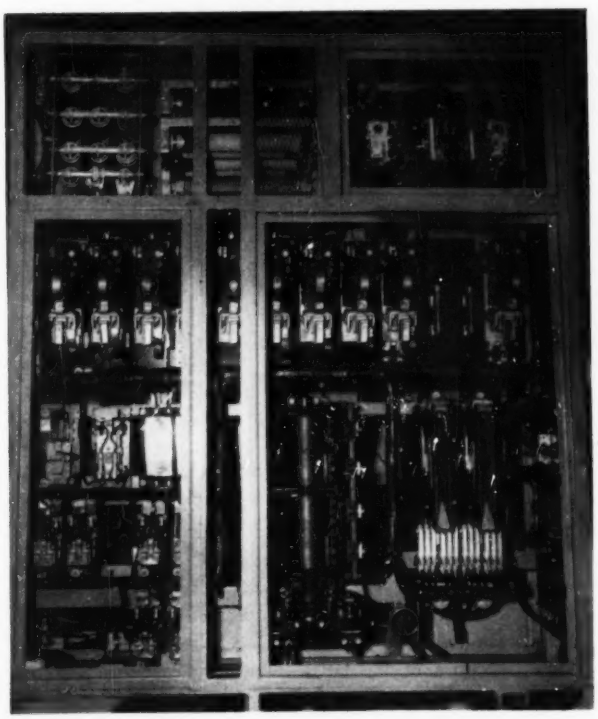
on rotating equipment should be inspected at frequent intervals in accordance with recommended schedules.

Close adherence to brush wear limits given in bulletins is recommended. These limits are 1 in. for auxiliary generators and exciters; 1⅜ in. for generators (types 471 and 489-B) and 1 7/16 in. (for type 480). Check should be made for brush spring tension which ranges from 2.25 to 3 lb. for auxiliary generators; 1.25 to 1.5 lb. for exciters; 2.25 to 3.25 lb. for main generators; 8 to 10 lb. for traction motors.

Dielectric Tests—

of main power circuits at voltages 50 to 75 per cent above normal working values are required annually by the I.C.C. It is further recommended that operating conditions of each railroad be examined to determine to what extent their testing schedule should exceed I.C.C. requirements. Although no dielectric test is required by I.C.C. for circuits operating below 150 volts, the builder recommends that control circuits on new locomotives have a resistance of at least one megohm and that the drop for locomotives in service be to not less than one-half this value. Equipment should be clean and blown out with dry air before testing.

Portion of electrical equipment cabinet used on a RF-16 road freight locomotive.



Mechanical

This division of the maintenance program covers a great many parts, both large and small, including the car body superstructure with its hoods, hatches, tanks, radiators, trucks, and many other parts.

The Air Compressor—

driven directly from the diesel engine will operate for long sustained service, when properly aligned and is given proper servicing attention. This includes maintenance of adequate lube oil supply, which involves keeping lube oil drain valves closed tightly with lock wires in place to prevent accidental opening; examination of unloading and check valves as often as necessary to prevent their stopping up with pipe scale, dirt, etc.; draining of air system at frequent intervals to prevent accumulation of water and dirt—neglect of this may cause trouble with control air system and upset entire locomotive operation; periodic air filter orifice cleaning and testing in accordance with I.C.C. rule #205-D.

Oil in Cooling System Indicated—

by water glass of cooling water expansion tank, should have immediate steps taken to locate source and repair of the defect. The first step is to blank off or remove the lube oil heat exchanger and air test it for leaks. If source of trouble is not thus found, the cylinder liners should be examined for cracks.

Under Engine Condition—

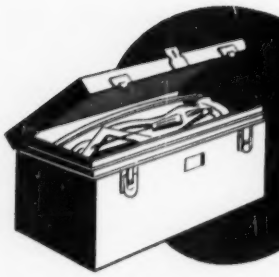
of the power plant should be free as possible from accumulation of oil and water as it not only reduces the fire hazard, but provides a cleaner working condition for personnel when making main generator examination of brushes and commutation.

Axle Journal and Motor Suspension Bearings—

are dependent for proper lubrication on close attention being given to the oil supply, oil box or oil cavity and whatever means is used to raise the oil up to the journal. Any indication of oil leaks should be investigated promptly and defect causing leak corrected at once. Manual instructions are comprehensive and should be adhered to closely.

Conclusion

The items of attention outlined in the foregoing are only a relatively few of the numerous items in the complete comprehensive maintenance program. However, if these items are given earnest and careful attention, the builders recommended maintenance schedules and bulletins studied, it is likely that the management will not regret their investment in this modern type of motive power. Let it be emphasized that cleanliness inside the engine room is the result of good workmanship and supervision, and the exterior appearance if clean and presentable looking indicates an efficient and well run organization.



Straight from the Tool Box

This is YOUR Department. Pass along your ideas to the other fellow. Send items to the Editor, preferably with a picture or sketch. Contributors will receive $10.00 for each item upon publication.

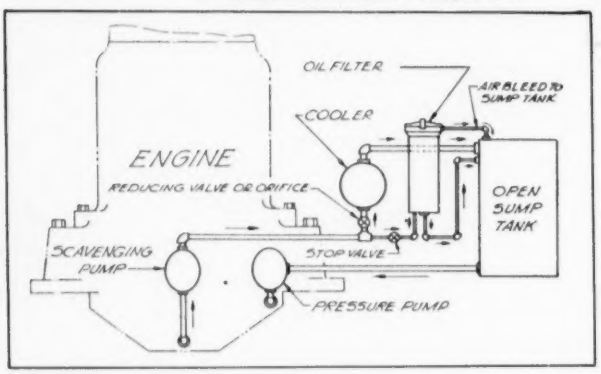
On Venting Filters

JOE CAULEY, TULSA, OKLAHOMA—Glad to see that you started the "Straight from the Tool Box" feature. It should be of real interest. I just had an idea that possibly you could use regarding filters. None of us like to clean them and so this point might be interesting. Saves money, too.

I had the job of changing filter elements in a lube oil filter and it kept coming up too often to suit me. Others were not so bad, but this one would build up pressure in no time. Being lazy, I tried to find out the reason. The first thing that I noticed was that most of the "gunk" was on the lower three-quarters of the elements. They tried to tell me that this was natural since the sludge was heavy and would sink down. I wasn't satisfied as the elements in other filters were pretty evenly loaded.

Principle expressed by this reader is illustrated as applied to a shunt system using two pumps and pressure filter. Similar arrangements are possible on full-flow and by-pass systems.

Illustration courtesy W. W. Nugent & Co.



An idea hit me one day when I was bleeding an air-bound centrifugal pump. I vented the top of the filter case, and sure enough, I got a hiss of air. First, I put on a petcock to let me bleed it every now and then but later (I said that I was lazy) I put in a very small vent line back into the sump. Now, the filter loads up evenly and the elements last longer. I never did find out where the air came from and don't particularly care. Venting the filter casing did the trick and I am going to do it on all filters in the future.

(Good idea and a sound point. Keep vents to minimum size so as to provide minimum effects on pressure and flow. Might be a good idea to find out where that air is coming from. It could be that the piping system, pump or pump suction location could be improved. There might even be some leaks, the stopping of which would improve overall efficiency.—Editor)

Stopping Stubborn Leaks

JACK RADKE, CINCINNATI, OHIO—Stubborn water leaks such as between cylinder liner flanges and engine blocks are frequently very difficult to stop. The leaks are usually due to corrosion and generally get worse as time goes on. We find that if the liner flange seat is repaired that the corrosion seems to progress faster.

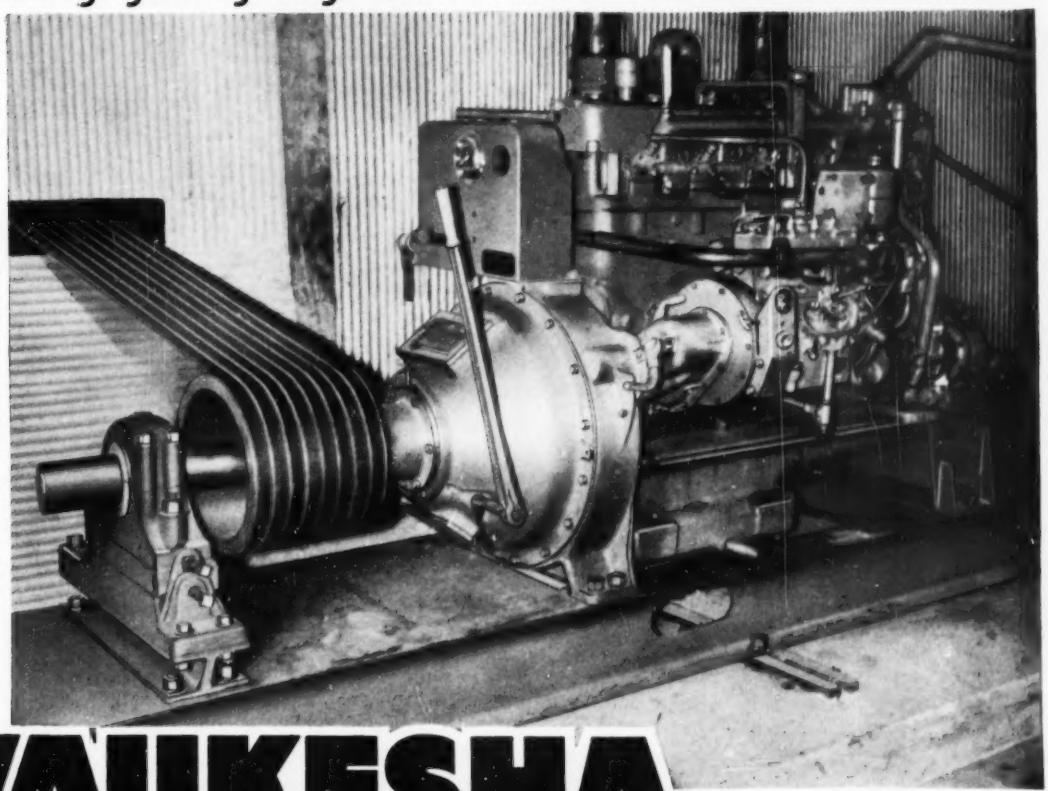
We finally solved the problem by using a gasket made of *Teflon* (A Dupont product). Teflon will soften and fill in all voids and stop the leak, and we found that the erosion and corrosion stopped too. We use Teflon in sheet form, 1/16th-in. thick.

(Note: Teflon should not be used for an exhaust line or manifold gasket as we are informed that it gives off dangerous fumes when heated to about 700° F.—Editor)

Teflon can also be used to great advantage for packing air-operated diaphragm valves as it does not harden and cause valve stem sticking.

Another good material borrowed from electric machine practice is *Glyptol* (a G.E. product). This material is fine for use between the diesel engine main frame and bedplate and other similar heavy pieces that usually are never taken apart again after initial erection. The material used as above is a good means to prevent stubborn and often unsightly oil leaks. *Glyptol* can also be used to advantage in making up good tight pipe joints, such as on lube and fuel oil lines.

"WAUKESHA DIESEL has given us uninterrupted power...to make every ginning day count"—SAYS L. D. HORTON of HOLLANDALE, MISS.



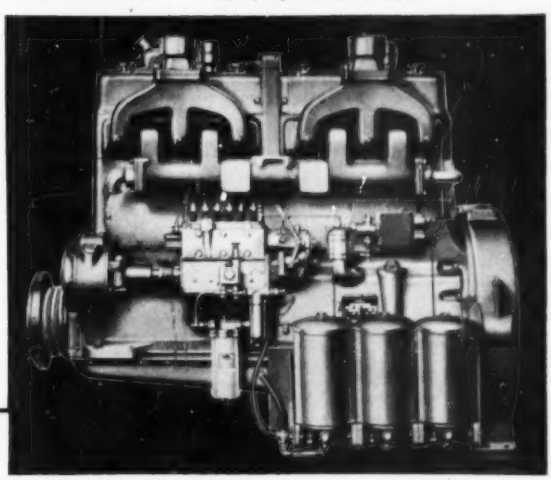
WAUKESHA ...modern GIN ENGINES

WAUKESHA 6-WAKD Diesel COTTON GIN ENGINE with gasoline engine starter—(above) as installed at gin of L. D. Horton, Hollandale, Miss.; (below) manifold side view. Maximum output, 201 hp. at 1300 rpm, with overload capacity up to 225 hp. at 1600 rpm. Bore is 6¼-in., stroke 6½-in., displacement 1197 cu. in.

Mr. L. D. Horton of Hollandale, Miss., is an experienced ginner. Here's what he says—

"When it was necessary to replace power in our gin, I decided to stick to a Diesel engine and install your Model 6-WAKD Waukesha Cotton Gin Unit. This Waukesha Diesel has given us a steady flow of uninterrupted power which every ginner should have, especially if the crop is short and you have to make every ginning day count. The engine is easy starting, simple and economical to operate. I have always felt that any machinery that operates as well as this engine should receive due credit and praise."

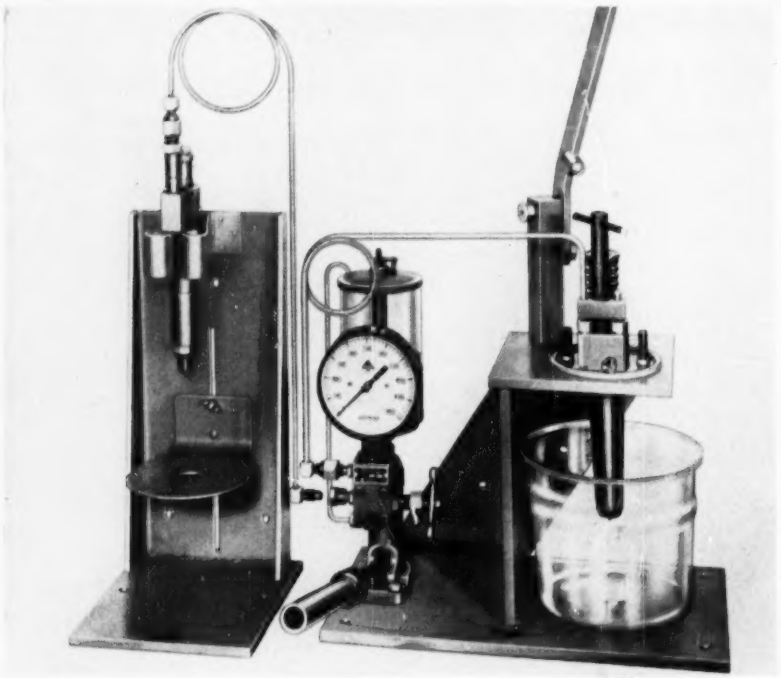
With its exclusive-patented, controlled turbulence combustion chamber, Waukesha 6-WAKD gives you unusual Diesel performance... complete *and* clean burning with all standard "high speed Diesel fuels"... lively acceleration ...and high economy. Send for Bulletins 1434 and 1535.



WAUKESHA MOTOR COMPANY • WAUKESHA, WISCONSIN

NEW YORK TULSA LOS ANGELES

New Products



New Nozzle Injector Testing Equipment

Expansion of its line of nozzle and injector testing equipment has been announced by the Bacharach Industrial Instrument Company. The new equipment comprises of several sets suitable for testing injection units of medium and large diesel engines.

One of these new nozzle and injector testing devices for heavy duty diesel power is illustrated. It comprises of specially developed and simplified fixtures, the Bacharach nozzle test pump, and fuel line connectors.

Nozzles and injectors which can be tested with this combination set include: Electro-Motive 567 and 201A injectors, GM 278 and 278A injectors, American Bosch T, U and V size nozzles and types AKA, AKB and AKK nozzle holders, Bendix-Scintilla C and D size nozzles and Types HCA, HCL, HCU, HCV, HDA, HDV and HDW nozzle holders, Fairbanks-Morse nozzles, and Ex-Cell-O nozzles for FM engines. Adeco and Demco nozzles may also be tested with this set.

New 1000-Ampere-Hour Signal Cell

A new "Eveready" 1000-ampere-hour copper-oxide signal cell has been announced by the National Carbon Company to round out its line of high-performance signal batteries.

The "Eveready" type 5-1000 signal cell employs a battery element of flat plate construction which consists of two molded copper-oxide plates and three zinc plates, assembled in a Standard A. A. R. glass jar with porcelain cover. The unit electrode is National Carbon's own original design and is especially strong and rugged. The new cell is similar in construction to the series of 500 ampere-hour "Eveready" copper-oxide signal cells types 3-500 and 5-500, but with double the ampere-hour capacity. Special features of the cell include a safety step insulator which prevents the possibility of internal drains between electrodes by foreign material bridging the insulators, and two inverted U-shaped indicator sections at the bottom of each outer zinc plate to give better visual indication of approaching exhaustion.

New Tachometer Dial Face

As a reminder to truck drivers that maximum horsepower is available only at the governed speed of the engine, Cummins Engine Company, Inc., has designed and copyrighted special tachometer dial faces.

The new face design will show the driver the approximate available horsepower as well as engine rpm. at all times. Old design tachometer dial faces only showed an engine's rpm.

Technicians believe this new tachometer dial face will help the driver and prevent engine lugging. New special tachometer dial faces for six different models—all for Stewart-Warner tachometers, are now available for Cummins diesels.

Engine Stand for Faster Service

A new engine stand to aid diesel engine shops in their repair work has been announced by the R & G Manufacturing Company.

The new device, known as the "All-Klear" diesel engine stand is different in that it engages the diesel heads from the side and does not block cleaning or other work on the manifold ends. The engine head is grasped firmly in a non-jiggling grip by four adjustable engaging pins that fit into the head bolt holes and lock into place. Loosening or tightening of the pressure brake permits rotation of the engine head to practically any angle for most convenient and speedy servicing.

A sub-assembly adapter is available to fit the "All-Kleer", permitting the operator to also service small diesel assemblies such as governors, fuel pumps, and similar items. Other features and accessories include heavy-duty rollers that permit moving the

fully-loaded engine stand anywhere in the shop, a removable oil drip pan of approximately 10-gal. capacity, and a convenient tool pan.

Engine heads and accessories weighing up to 800 lb. can be handled with this equipment. Special, interchangeable engaging pins make it possible for the stand to handle nearly every make of diesel head.

New Chevron Tool

A new model puncturing tool, for use with the priming system for Chevron starting fluid capsules, is being produced by The California Oil Company.

Upper and lower chambers of the tool are protected by overlapping metal skirts. The tool is an aluminum die casting, and cannot crack or break. Another new feature is a plug and screen trap at the end of the lower chamber which may be removed for easy cleaning. The plug is attached also to the tool and its mounting by a chain so it will not be lost if shaken loose by jars or vibrations.

Fuel Dehydrator

A fuel dehydrator, for the removal of water from gasoline, fuel oil, diesel oil and kerosene, has been designed and put on the market by the Bowser Company. Made in two sizes, with capacities of 350 and 600 gpm., the new device permits effective dehydration and automatic water ejection at high flow rates.

Durably built without moving parts, the dehydrator employs non-absorptive fibre glass dehydrating elements that will not decompose. In installations where there is a possibility of encountering large volumes or "slugs" of water a special control mechanism is available, which prevents water from entering the fuel discharge line.

Improved Air Horns

A new Swedish invention which improves the efficiency and tone of air horns and whistles, has recently been announced by the Leslie Company.

The new air horn, known as the "supertyfon" is the invention of sound expert, Gustav Broden, development engineer of Malmo, Sweden.

Arrangements for the Leslie Co. to manufacture the "supertyfon" in the U. S. and Canada were consummated on Mr. Leslie's recent trip to Sweden.

Engine Stethoscope

The problem of locating friction noises in bearings, pistons, gears, ratchets, cams, clutches, traps, pipelines, valves and other mechanisms is answered by a new, portable electronic instrument, according to Anco Instrument Division of Chicago.

Known as the "elec-detec", this electronic stethoscope employs a metal probe which serves as a microphone transmitting impulses electrically to headphones. It localized the sources of tell-tale noise, helps diagnose the trouble and determine quickly where to make repairs without tearing down the entire equipment, it is stated.

According to the manufacturer, the electric amplifier and the sensitivity control on the device makes it possible to detect sounds at low speed that otherwise could be heard only at high.

Like a police dog

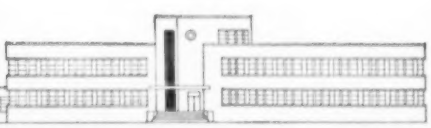
it watches and protects your engines

Oil pressure failure or overheated cooling water can happen anytime ... and it can happen to the best engine! But serious damage and costly repairs resulting from such minor troubles *can be prevented* with a PENN Safety Control.

Here's how it works. If water temperature rises beyond the predetermined safe point ... or if oil pressure falls too low ... the PENN Control goes into action! It automatically sounds an alarm, flashes a warning light or stops the engine operation ... whichever you choose. Then, the minor fault can be investigated and corrected before major damage occurs.

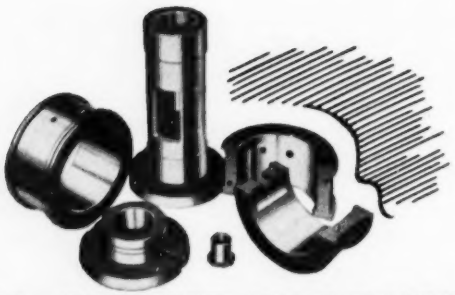
Simple to install on new or old engines, PENN Safety Controls are available in three basic models (1) oil pressure only (2) water temperature only (3) combination pressure and temperature. Learn more about this *low-cost protection,* send for Bulletin E-100. Write **Penn Electric Switch Co., Goshen, Indiana.** Export Division: 13 E. 40th St., New York 16, U. S. A. In Canada: Penn Controls, Ltd., Toronto, Ont.

PENN



AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, PUMPS, AIR COMPRESSORS, ENGINES, GAS RANGES



DIESEL SLEEVE BEARINGS
of ANY TYPE

Precision-made Johnson Bearings contribute to the performance of many kinds of equipment . . . from great diesels and gigantic industrial machines to automobiles, to tiny electric motors. Johnson Bronze produces sleeve bearings for every purpose, in all types, in a vast range of sizes. From this wide experience they have gained invaluable knowledge on bearing applications of every kind.

You may profit by consulting with Johnson Bronze engineers on your diesel needs. They have helped others decide on the correct bearing. They will gladly study your requirements and make recommendations on the type and design of bearings needed. Write, wire or call today for an appointment.

for your files . . .

FREE • A series of data sheets, prepared by Johnson engineers, is written in concise, factual form. They cover tolerances, alloys, bearing design, lubrication, powder metallurgy, etc. Write for a set.

Johnson Bronze
SLEEVE BEARING HEADQUARTERS
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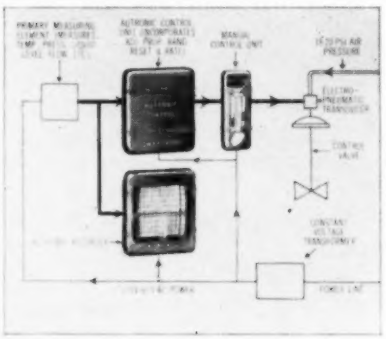
Electronic Control System

A new automatic all-electronic instrumentation and control system for use in refineries, petrochemical installations, industrial power plants and central stations has been announced recently by The Swartwout Company.



Known as the "autronic control system", it is claimed to be the first centralized-control, miniature, all-electronic system for measuring and controlling process variables such as temperature, pressure, level and flow.

The system consists essentially of three basic units: primary sensing element, autronic control unit, and final control element. The primary sensing element generates a voltage which is directly proportional to any change in the process variable. This voltage, always within the same range regardless of whether temperature, pressure, flow or level is being measured, is transmitted to the autronic control where it is continuously modulated by electronic means. The autronic control unit then transmits the resulting direct current to the final control element which may be either electrically or pneumatically operated. If a graphic presentation of the process is desired, an autronic recorder can be plugged into the circuit.

New Regulating Valve

Hydraulic Equipment Company has recently developed an automatic plunger type oil hydraulic flow regulating valve (450) series. This flow regulator is designed particularly to eliminate hydraulic voids in cylinder operation where, in lowering heavy loads, the operating cylinder tends to lower faster than the pump can supply oil to it or in systems where linkage is such

that over center operation is involved. Designed for double-acting cylinders, the 450 series valve regulates the flow of scavenger oil from the double-acting cylinder at the same rate as oil is supplied by the pump to the power side, so eliminating any hydraulic void and subsequent loss of control.

Adapted to the new Sherman Digger, the 450 series valve controls accurately the rate of lowering of the loaded shovel so that at no time can the load run away from the operator. They are available in various capacities up to 25 gpm. at 1000 psi.

"Cat" Mufflers

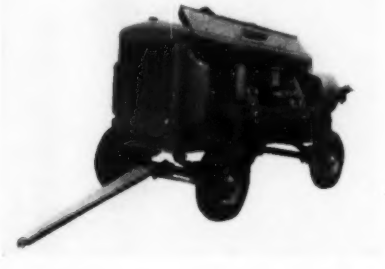
The sound of a 225-hp. tractor engine may be music to the ears of the contractor, but sometimes he needs to turn the music down.

That's why Caterpillar Tractor Co. recently offered a complete muffler group for the new diesel DW20 and DW21 tractors, similar to that offered for the smaller DW10.

The new attachment will reduce engine exhaust noise, providing greater operator comfort and reducing annoyance for people living near job sites.

New Diesel Air Compressor

Highway, heavy construction contractors, and quarry operators, now have available for their use the new standard model 365 air compressor, manufactured by The Jaeger Machine Company, and featuring diesel power by Cummins.



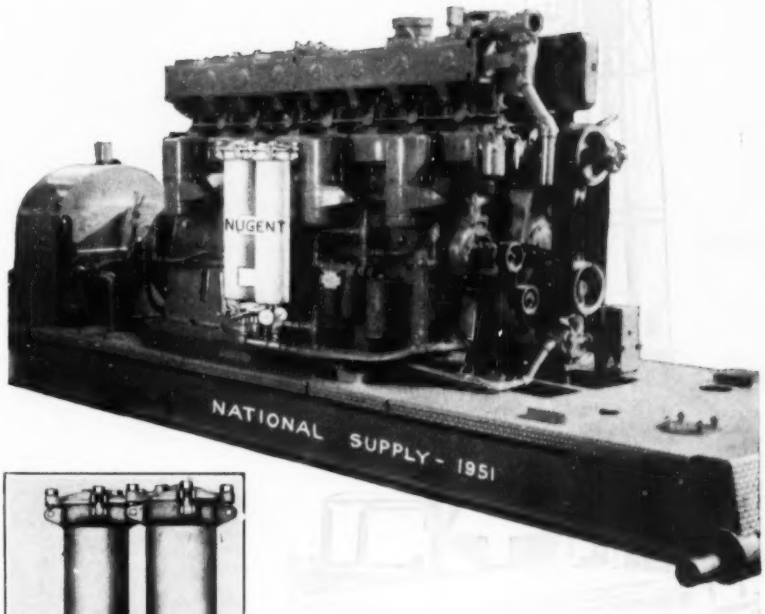
The new compressor, rated at 365 cu. ft. of air per minute at 100 psi. pressure, utilizes a 165-hp. model HRBI-600 Cummins diesel for its power plant. Engine operating speed of the diesel-compressor unit is 1240 rpm.

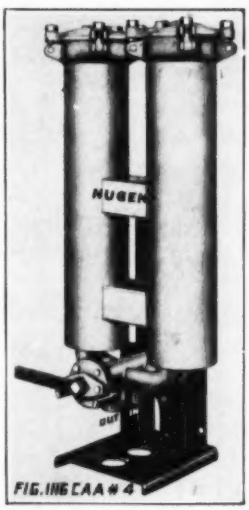
Both the engine and compressor are mounted on structurally welded main frames. The heavy duty wagon has an

NUGENT *Full-Flow* FILTERING...

...lengthens diesel engine life

...increases engine dependability





Illustrated above is one of several National Superior diesel powered drilling rigs for American Arabian Oil Company equipped with Nugent Full Flow Filters of the type shown.

NUGENT Full Flow Filtering of lube oil is the practical way to provide a maximum of lubrication protection for vital engine working parts. With Nugent Full-Flow Filtering *all* the oil being circulated through the engine is filtered every cycle. Dirt, carbon and foreign matter are removed as soon as they get into the oil. No oil bypasses the filter, because it is the foreign matter in by-passed oil that does the damage.

Nugent Full Flow Filters are made in a complete range of sizes for all sizes and makes of diesel engines. They utilize inexpensive replaceable bag-type charges having 20 times the filtering area of other filters of comparable size.

To get maximum dependability and useful life from your diesel engines, you can't afford to be without Nugent Full-Flow Filters. Write for complete information.

NUGENT TRADE MARK

Wm. W. Nugent & Co., Inc.

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OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

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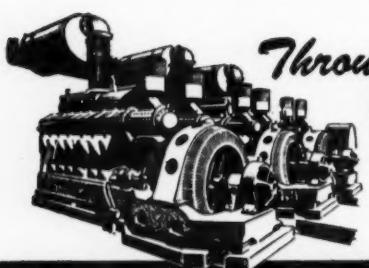
The right ratio of surfaces – the right materials – the right velocities – the right proportion between coil area and depth . . . there are dozens of factors that affect the efficiency, maintenance and service life of heat-exchange coils.

For best performance in your own application, the practical approach is to take full advantage of the unequalled engineering, research and design skill — the unequalled manufacturing and testing facilities — which Aerofin offers you.

To get the *right* answer – ask the Aerofin man.



Throughout the Power Industry –

Aerofin units do the job Better, Faster, Cheaper

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Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

"auto-steer" front axle, and can be hauled safely at 35 miles per hour over rough roads. Steel wheels or skid mountings are also available.

Length of the complete rubber tired unit is 12 ft., 3 in.; width, 5 ft., 10½ in.; height, 6 ft., 9 in.; and weight, 8500 lbs.

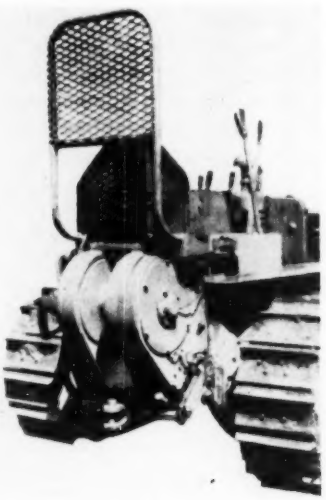
New German Diesels

In order to meet the increasing demand for small diesel engines of high speed, Motoren-Werke Mannheim, Mannheim, Germany has included in their production program a new series KD 11 diesel engine, which is built in a 1- and 2-cyl. type, ranging from 5 to 17 hp. at a speed of 1250 to 2000 rpm.

These machines were introduced to the European market two years ago and are now offered to the U. S. market on short delivery terms.

Hyspeed Winch

Designed to supply increasing demand for a lightweight, free-spooling tractor winch with fast line speeds and quick positive brake action, a new D4 HySpeed winch has been developed by the Hyster Company and is available for immediate delivery from Hyster-Caterpillar dealers.



The new winch can be mounted on either seat or fender tank type "Caterpillar" D4 tractors. It has many applications as a production tool, as well as for service, maintenance and general utility. A few of the jobs it will perform are lifting, pulling, crane

"WHY HAVEN'T I HEARD OF THIS BEFORE?"

This is what so many diesel operating men ask the first time they see a copy of DIESEL POWER & DIESEL TRANSPORTATION.

And we find, every day, as the diesel field widens, that so many of the men in it, do not know about this valuable magazine—devoted exclusively to diesel.

THEREFORE . . . to expand our service to the diesel industry and all the men in it—and to give our subscribers every possible advantage . . .

you can win a **FREE** copy of one of these VALUABLE REFERENCE VOLUMES.

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For every 2 new subscriptions to DIESEL POWER, we will award a copy of the New "FUEL INJECTION SYSTEMS", which sells for $1.50, and is advertised on another page of this issue.

For every 5 new subscriptions to DIESEL POWER, we will award a copy of the "DIESEL ENGINEERING HANDBOOK", Deluxe Edition. This volume covers the entire field of land and marine diesels . . . and sells for $7.50.

*****

Address all subscription orders, correspondence and questions on the above to:

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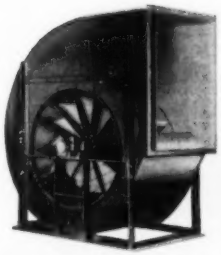
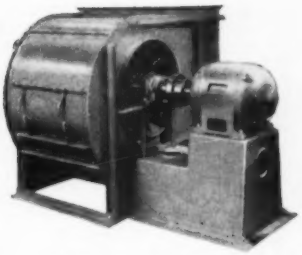
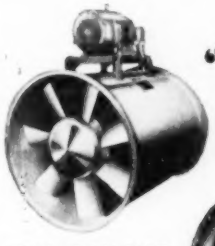


LIMIT-LOAD FANS.—For large-scale ventilation. Quiet, non-overloading. Sizes up to 500,000 c. f. m. Bulletin 3675.



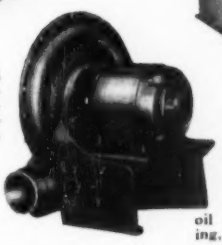
POWER PLANT FANS.—Primary forced draft, induced draft—built for the severest service. Bulletin 3750.



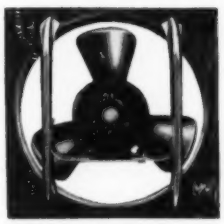
AXIAL FLOW FANS For light-duty ventilation and air conditioning service. Compact, non-overloading. Bulletin 3533-C.

"Buffalo"

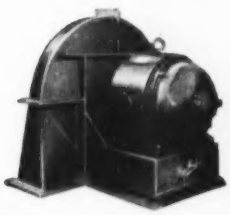
INDUSTRIAL EXHAUSTERS With interchangeable wheels for air exhausting or materials conveying. All-welded. Bulletin 3576.



"E" BLOWERS-EXHAUSTERS. For oil or gas furnace blowing, line boosting, cleaning. Bulletin 3014-C.



BREEZO FANS. — Easy-to-install wall fans. Durable and very economical. 6 sizes. Bulletin 3222-F.



TYPE "CB" AND "CC" PRESSURE BLOWERS.—In sizes for pressures up to 4 pounds and capacities up to 75,000 c. f. m. Bulletin 3553-A.

"Buffalo" BUILDS THE RIGHT FAN FOR THE JOB

Whether you need to ventilate a small room or an entire factory—clean tools with air or give your boiler system the most efficient mechanical draft—"Buffalo" builds the fan for the job! And whatever "Buffalo" fan you pick, you can know that its performance is backed by 73 years of "air know how." Take a look at the fans shown here, and write us for engineering bulletins by number of any that might fit your particular application.

—AND FOR PUMPS . . .

You'll find a rugged precision-built "Buffalo" Centrifugal Pump of the right design, the right metal or alloy and right capacity to handle your liquid-moving job most efficiently. WRITE FOR FACTS!

BUFFALO FORGE COMPANY
and
BUFFALO PUMPS, INC.

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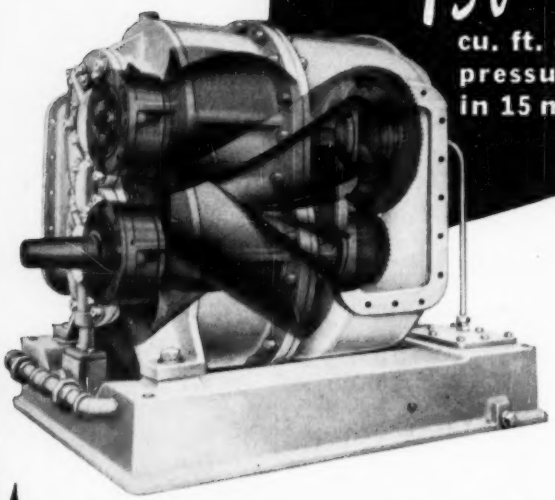
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Canada Pumps, Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

this STANDARDAIRE handled 1/3 billion cu. ft. of high pressure air in 15 months



Then we dismantled the unit

. . . FOUND IT AS GOOD AS NEW

- Unit 9B16-213, for 15 months of day and night outdoor service, was operated beyond its rated capacity to meet unforseen demands. It was replaced by a larger Standardaire Blower. The engineer of this plant asked that the hard working unit be sealed and returned to our factory so that he personally could observe the dis-assembly and measurements for wear.
- Main and Gate Rotors like new —interior of blower completely dry and free of oil—no wear in other internal parts.
- Timing Gears on Gate and Main Rotors—wear very slight—no increase in back lash could be detected.
- Axial clearance of Main Rotor Shaft Thrust-Radial Bearing, increased less than .0005"—other bearings in perfect order.
- Even at the extremely high peripheral speed of these gears, they were found to be very quiet in service.
- Standardaire Blowers are sturdy —precision built units with proved staying power.

Write for specific data—Dept. E49. Read Standard Corporation, 370 Lexington Ave., New York 17, N. Y.

AXIAL FLOW STANDARDAIRE BLOWER

BLOWER-STOKER DIVISION

READ STANDARD CORPORATION

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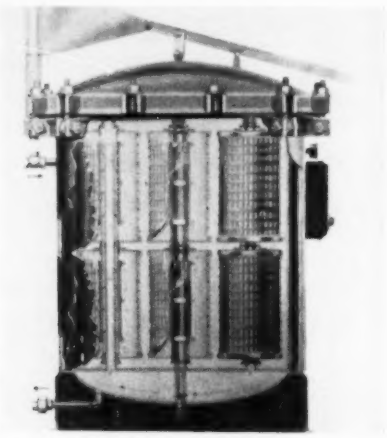
work, light pile driving, ground skidding logs, bundling pump logs, skidding bundled pulpwood, "feeder cat" work in logging and a new method of forming and transporting bundles of pulpwood logs.

Fuel Oil Filters

Hilliard announced recently a new line of improved type Hilco "hyflow" lubricating and fuel oil filters.



These new units include swingbolt head construction for quick opening of filter covers and a lifting device for ease of handling the cover. Filters are available using factory-made throwaway cartridges or the repackable type which the operator repacks from bulk supply of filtering materials. Filtering materials are available for use in these units for handling straight-run mineral oils, or the heavy-duty detergent type oils, a feature being that all types of filter cartridges, both factory-made and the repackable type, are interchangeable.

The filters are available in capacities ranging from ½ gpm. up to 1000 gpm., for fuel oil filtering, lubricating oil bypass, or full-flow filtering.

New Water Filter

The Butler Engineering Company has announced a new water filter, model C-40. This unit is a combination of a centrifugal filter and descaler. It is installed into the closed cooling systems of internal combustion engines, similarly to a cab hot water heater where the inlet is connected to the head of the engine, and the outlet is the suction of the pump, and water

is continually circulated through the filter.

It is novel insofar as the filtering mechanism depends upon the spinning of the water and the throwing of the solid particles into the bottom visi-bowl collecting chamber. There are no screens or filter pads to clog this unit, and there is a full flow at all times, it is claimed.

The center core of the unit which is the de-scaler automatically conditions and treats the water as to its scale forming ability and corrosive nature.

New Literature

Electrical Supply Buyers Guide

The Surplus Materials Corporation has recently issued a new Electrical Supply Buyers Guide for August, September and October. This 23-page booklet contains a complete listing of all products with their specifications and prices.

Nickel Booklet

The International Nickel Company has recently issued a 36-page bulletin describing eight types of austenitic nickel alloy cast irons that offer unique combinations of properties.

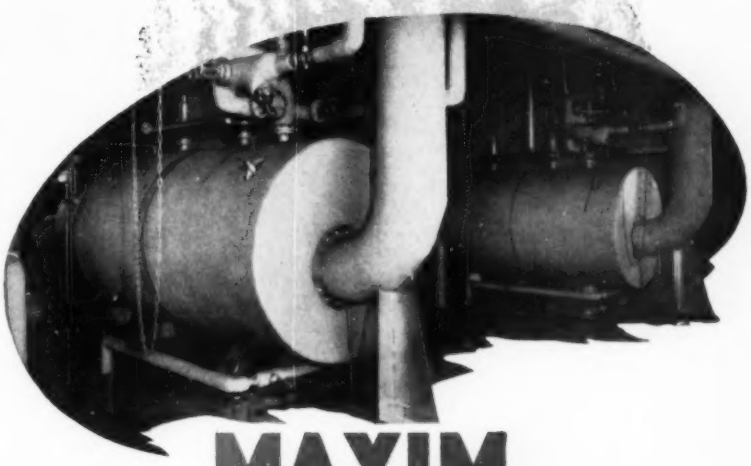
Applications and comparative service data in many industrial fields are presented to prove the utility of "ni-resist" in withstanding corrosion, heat, wear and low temperature. High or low controlled expansion, magnetic or non-magnetic properties and resistance to thermal shock add variety to its usefulness. It is a reference booklet, well illustrated with photographs, tables of properties and corrosion data on nearly 400 conditions.

Casting-Welding Manual

The Steel Founders' Society of America has recently published a comprehensive new manual incorporating advanced technical data on welding of steel castings.

Based on studies carried out by the society, member companies, and professional research engineers, the 40-

IS WASTE HEAT WASTING YOUR MONEY?



MAXIM

HEAT RECOVERY SILENCERS CONVERT WASTE EXHAUST HEAT TO USABLE STEAM or HOT WATER

A big Los Angeles Sewage Disposal Plant found that Maxim Heat Recovery Silencers provided all the steam necessary for plant heating as well as heating the sludge — *and from exhaust heat that would otherwise have been wasted.*

Perhaps your own operating expense picture can be improved by this simple and effective way to provide extra steam or hot water for heating or processing operations while at the same time effectively silencing exhaust noise. Our engineering department will be glad to make recommendations.

Automatic Controls

In figure E water is low and there is less effective heating surface (heating surface in contact with water), hence lower steaming rate.

In figure F water is high and gives greater effective heating surface — higher steaming rate. Steam pressure regulated valves control the amount of water to produce desired steam capacity.

Consult MAXIM

THE MAXIM SILENCER COMPANY 93 HOMESTEAD AVE., HARTFORD 1, CONNECTICUT

Dept. WL Gentlemen: Please send me your Bulletin on Heat Recovery Silencers

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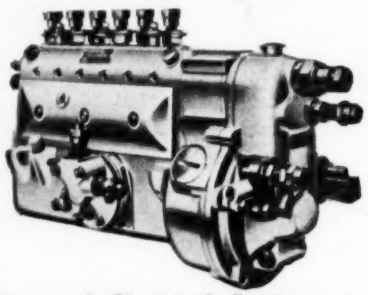
Transport operators all over the world have learnt to trust this sign.

In any language the letters on the C.A.V. sign stand for first-rate service facilities, maintained by highly-trained craftsmen, using special precision equipment.

Wherever vehicles fitted with C.A.V. Fuel Injection Equipment are exported — whether to Trondheim, Santiago, Hong-Kong or Sydney — there's a service agent or depot to give it the specialist attention needed for such high-precision equipment.



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Fuel Injection and Electrical Equipment

Service Depots throughout the World

C.A.V. DIVISION OF LUCAS ELECTRICAL SERVICES INC., NEW YORK 19, N.Y. Sales Office: 14820 DETROIT AVE., CLEVELAND 7, OHIO

page report is entitled "Recommended Practice for the Welding of Steel Castings". Procedures outlined are equally adaptable to the needs and problems of the fabricator as well as the foundry.

Bound in three sections, the society manual includes detailed textual consideration of established procedures, tabular classification of electrodes, trade-name products and manufacturers for all classes of electrodes, compositions and recommended procedures for carbon steel and low alloy steel castings, bibliography, etc. Numerous drawings are included to illustrate specific approved welding sequences. The price is 35¢ per copy.

Sludge Pump Booklet

The Ralph B. Carter Company have released the latest in their series of technical bulletins on equipment for liquid processing and industrial waste treatment.

The 16 pages include detailed information, engineering data and specifications on their complete series of plunger sludge pumps. Pump and motor selection charts, plus specifications and lubrication data—along with essential data on diaphragm pumps for general duty are included.

Fire Protection Booklet

What one should know about modern fire-fighting devices and the different fire extinguishing agents used in them, is contained in a new 32-page illustrated booklet titled "Correct Fire Protection", published by the American-LaFrance-Foamite Corporation.

The booklet points out that all fires are not alike, and that operators of fire extinguishing equipment must know the correct extinguisher for use on the kind of fire to be extinguished. It illustrates and describes the various sizes of units available for use with the different kinds of fire extinguishing agents.

Ammeter Brochure

A 16-page manual entitled "Servicing with the Amprobe" is now available from the Pyramid Instrument Corporation.

The booklet has as its primary aim how to make servicing jobs easier. It consists of case histories of service men and others telling how they used the Amprobe snap-around volt ammeter. This instrument is an ac. ammeter and voltmeter, in one pocket-size instrument.

Index to NEMA Standards Publications

A descriptive index to National Electrical Manufacturers Association Standards Publications was published in 1948 to aid the users of NEMA Standards in choosing those which would best meet their individual needs.

A 1951 revision of this descriptive index has now been published. The Standards themselves are designed to eliminate misunderstandings between purchasers and manufacturers and to assist the purchaser in selecting and obtaining the proper product for his particular need. They define a product

process or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, quality, rating, testing and the service for which designed. The index to the Standards is alphabetically arranged, and a brief description is given of each Standard.

Allis-Chalmers Bulletins

Construction details of Allis-Chalmers totally-enclosed, fan-cooled motor are described in a new bulletin released by the company.

Another bulletin describes the company's package pumps, engineered for a wide range of fractional horsepower applications in capacities to 30 gpm. at heads to 100 ft.

New Lathe Attachment Catalog

More than 160 different attachments and accessories for lathes, drill presses and shapers are illustrated in a new 35-page catalog issued by South Bend Lathe Works.

Several new items are cataloged, including some recently developed attachments not previously announced. Although these attachments and accessories are designed primarily for use on South Bend machine tools, many of them can be easily adapted to other makes.

Molybdenum Lubricant Bulletin

The Alpha Corporation has recently issued a bulletin entitled "Molykote Lubricants for Industrial Applications". It includes eight pages of industrial case histories describing the use of "Molykote" (whose basic ingredient is molybdenum) in various applications including machine tools, dies, press fitting, threaded connections, taps, extreme temperature lubrication, cold forming, cold heading, instruments and sundries.

Filter Booklet

Complete engineering data on synclinal type filters for sump or line installation on all hydraulic and low pressure liquid recirculating systems is contained in a folder recently published by the Marvel Engineering Company.

The filters are available in single-unit capacity sizes from 5 to 100 gpm. Choice of filter mesh is from 30 to 200.

"Cat" Maintenance Guide

Caterpillar Tractor Company has issued a maintenance guide in an attractive colored cartoon makeup.

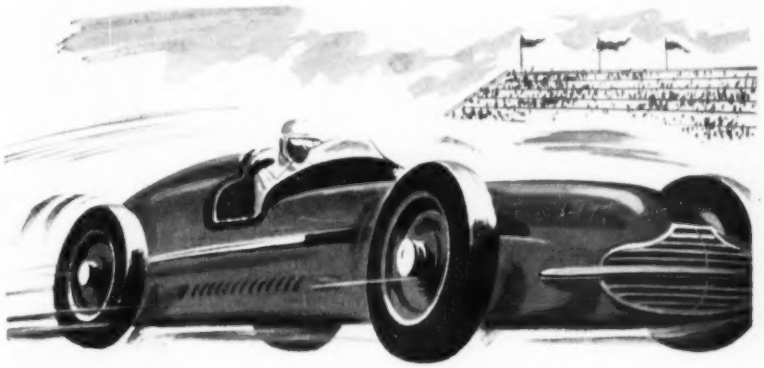
This guide presents information on the service of diesel engines, electric sets and marine engines.

Airhorn Bulletins

Kahlenberg Bros. Company has recently issued a series of bulletins describing their airhorns and accessories.

Bulletin 33 tells of the fields in which these airhorns have application, including marine, trucks, busses, tractors, locomotives, switchers and diesel trains.

Bulletins 33-1, 33-2 33-3, 33-6 illustrate and describe various models of airhorns and give specification charts Bulletin 33-8 describes and illustrates various accessories.



Winners use MONMOUTH

MONMOUTH Thinwall Bearings are the choice of winners at the 500-mile Indianapolis Speedway Races.

In 1950, 8 of the first 10 cars to finish the race used Clevite 77 and Micro type Monmouth Engine Bearings.

In 1951, all 8 cars that finished the race used Clevite 77 and Micro type Monmouth Engine Bearings. The average speed of the winner was 126.244 miles per hour for the 500-mile race.

Monmouth Engine Bearings are designed and constructed, tailor-made if you please, for the work they have to do. This we call "Engineered Performance". It is just as important to Diesel engine performance as in a Speedway race car. It is a quality found in no other engine bearing. In the maintenance of Diesel engines — whether marine, stationary, or in prime movers — specify Monmouth Engineered Bearings.

All Monmouth Replacement Parts are engineered and precision made to safeguard the reputation of the master Diesel engine mechanics and insure user safety and satisfaction.

THE CLEVELAND GRAPHITE BRONZE CO.
REPLACEMENT SALES DIVISION
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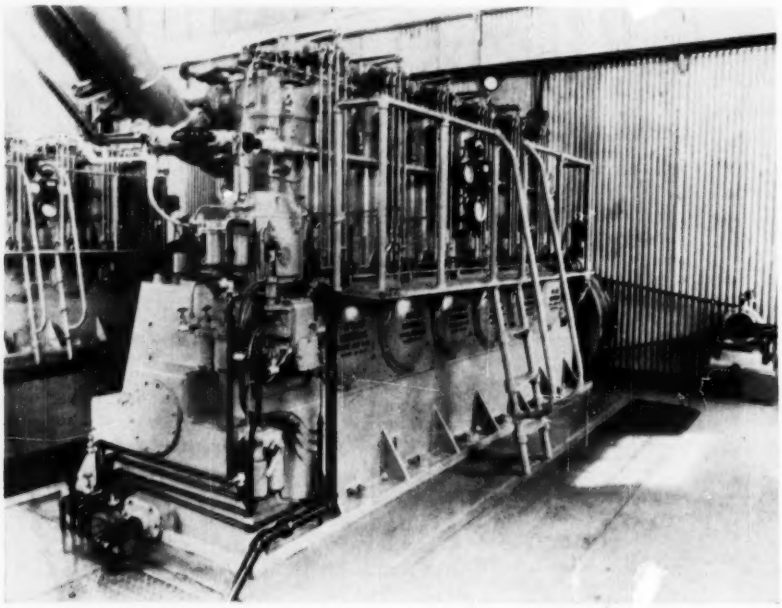
Field Notes



Diesels Pile Up Enviable Record on Pipeline

A Texas Company which operates 1,400 miles of trunk and gathering lines to serve a great part of Texas have kept their pumping costs down by taking advantage of the diesel's high availability and efficiency.

One section of the pipeline is handled by diesel engine driven pumps taking oil at 10 psi. and raising it to 900 psi. for discharge into the line. The diesels are 6-cyl., 327-rpm., 400-hp., Atlas units connected to the pumps through a gear drive. Although being consistently overloaded during the war years, and operating on a 12,000-hr. overhaul schedule, the engines have run up an enviable record.

After 70,000 hours of operation more than 80 per cent of the original main bearings and 60 per cent of the original connecting-rod bearings were still in use, and average cylinder wear was about 0.022 in.

Records of one station show that in a 25-month period one engine was available for service 100 per cent of the time while the other, down for servicing 40 minutes, had an availability of 99.99 per cent.

In one year the two engines pumped almost ten million bbl. of oil. During this period, they consumed 192,832 gal. of fuel oil and 833 gal. of lubricating oil. At 6 cents a gal. for fuel oil and 70 cents per gal. for lube oil, the cost of fuel and lube oil was only 1.2 mills per bbl. of crude pumped into the pipeline.

Aluminum Industry Has 17 Per Cent Output Rise

America's aluminum industry has widened further this year its margin of world leadership through a 17.5 per cent production increase and a strong start on a $500,000,000 expansion.

Even before conclusion of the enlargement program, which is about 15 per cent complete and gaining momentum rapidly, plans for another large addition to productive capacity —perhaps equal to one third of the industry's pre-Korea size—may be announced.

Top defense officials have been exploring the possibility of adding 500,000,000 lbs. of raw aluminum capacity to the 1,300,000,000 lbs. of expansion already approved and scheduled to be in operation by the early part of 1953.

With military demands for this key material growing constantly, the first six months of 1952 allocations for producers of less essential goods made of aluminum may be trimmed to only 15 per cent of the amount they consumed last year. Direct military requirements, the stockpile and the makers of essential products are getting 65 to 75 per cent of the primary, or basic, aluminum produced in the United States.

New Equipment for Canadian Pacific

During the period from October 19 to November 20, 1951, the Canadian Pacific Railway received one 1500-hp. diesel electric freight "A" unit (with steam generator) from General Motors Diesel, Ltd., completing an order of four, one 1500-hp. diesel electric freight "B" unit (with steam generator) from the same company, completing an order of four; and eight 1500-hp. diesel electric freight "B" units from General Motors, Ltd., making a total of eight received on an order for ten.

GM Pushing Defense Vehicles

The GMC Truck & Coach Division of General Motors has since June 1950 completed or contracted for approximately $30,000,000 worth of regular commercial trucks for the armed services and other government agencies involved in national defense, it was recently announced.

This has enabled hundreds of outside suppliers to share in the defense work, which involves nearly 9000 truck units of all sizes and types, without the necessity of obtaining new tooling equipment.

The trucks and highway tractors already delivered or being assembled include pickups, stakes, dumps, water

tankers, gas tankers, ambulances, vans, buses, wreckers, panels and suburbans. Among the highway tractors are a number of GMC 650 diesels delivered to the Army Transportation Corps for test purposes.

This defense production has been done and is being carried on by GMC's regular commercial assembly lines and is in addition to the production on the GMC military 6 by 6 tactical vehicle which started last month.

DEMA Offiicers and Directors

At a recent meeting of the Diesel Engine Manufacturers Association the following officers were elected to serve

for the calendar year of 1952: Otto H. Fischer of The Union Diesel Engine Company, top, was elected president; Levin H. Campbell, Jr., of International Harvester, left center, vice president; A. W. McKinney of The National Supply Company, right center, vice president; Robert H. Morse, Jr., of Fairbanks, Morse & Co., left bottom, is the new treasurer; and Harvey T. Hill of Diesel Engine Manufacturers Association, right bottom, is secretary and executive director.

Directors elected are: William S. Morris, American Locomotive Co.; Walter A. Rentschler, Baldwin-Lima-Hamilton; C. Paul Clark, Clark Brothers; Gordon Lefebvre, The Cooper-Bessemer Corporation; William E. Butts, Enterprise Engine & Machinery Co.; George W. Codrington, Cleveland Diesel Engine Division, General Motors Corp.; M. C. Davison, Ingersoll-Rand Co.; Robert E. Friend, Nordberg Manufacturing Company; and Edwin J. Schwanhausser, Worthington Pump and Machinery Corp.

Air-Maze Buys Detroit Air Filter Company

The Air-Maze Corporation, Cleveland, Ohio, has purchased the Detroit Air Filter Company of Woodstock, Illinois.

Manufacture of "Detroit", "Arco" and "Dustay" filters will be continued at Woodstock. The filters are of the "throwaway" type and incorporate "wick action" as a method of holding more adhesive on the filter media.

CONTROL POWER BETTER

ROCKFORD CLUTCH DIVISION
BORG-WARNER
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ROCKFORD CLUTCHES

American Air Filter Forms New Company

The Canadian business of the American Air Filter Company, Inc. Louisville, Kentucky after January 1, 1952 will be handled by American Air Filter of Canada, Ltd., Montreal, P. Q. Mr. William G. Hole, formerly of Darling Brothers, Ltd. will be in charge of all Canadian operations. Representatives will be established in the larger Canadian cities to handle the American Air Filter line of air filters, electronic precipitators and Roto-Clone dust collectors.

New Nordberg Distributor

Appointment of Eighmy Equipment Company of Rockford, Illinois, as distributor for Nordberg 4FS diesel engines in the northwestern and central section of Illinois is announced by Nordberg Manufacturing Company, Milwaukee, Wisconsin.

The company maintains a well tooled machine shop staffed with competent, trained servicemen and has a complete parts department. The sales and service facilities are housed in a building occupying some 3000 sq. ft. of floor space. In addition, the organization has three acres of demonstration ground and storage facilities west of Rockford.

Rock-Island Dieselizes Suburban Service

The Rock Island Lines today accepted delivery of the last of 15 locomotives which will make possible the complete dieselization of the suburban system by December 17, when new schedules will become effective.

The locomotive was received by president J. D. Farrington of the Rock Island Lines at a ceremony held in LaSalle Street Station. All the new engines were manufactured by American Locomotive Company and General Electric Company in Schenectady, New York, and were delivered during November.

The 15 new diesels, each capable of 80 mph. speed, cost more than $2,600,000. The new equipment, plus two others already in service, will replace 28 steam-type locomotives which originally powered the suburban service.

Illinois IT Inspection Course

Illinois Institute of Technology has received a contract to train 90 Chicago Ordnance District workers in the fundamentals of precision inspection. The course will be given in three sections, each of five weeks duration. Each section will contain 30 students.

Those who complete the course will be qualified in the use of equipment for precision measurement and gauging of war material. They will study inspection practices, quality control, blueprint reading, shop mathematics, fundamental metallurgy, and manufacturing processes.

New Insulation from Silicone

Silicone rubber treated glass cloth for motor and cable insulation is now in production at General Electric's Coshocton, Ohio plant, it was announced recently.

In the dipping process that is used the glass cloth is passed through a liquid solution of silicone rubber. After the application of heat to cure the rubber, the treated fabric is ready for use. The process is continuous.

The chief use of silicone rubber treated glass cloth at present is for motor and cable insulation. Having high heat resistance and excellent flexibility and electrical properties, the material is ideal for these applications. It is anticipated that other uses will be developed in the electric industry, and requirements for defense applications may require substantial quantities.

New Raybestos Plant in Operation

Production in Raybestos-Manhattan, Inc. new Wabash Division has started recently in a 70,000 sq. ft. plant, newly constructed to manufacture sintered metal products for the military defense program. Two units have been built on a 62-acre tract; a main building which contains the manufacturing facilities and administrative offices and a service building which houses the power plant with boilers, compressors, water softeners and an electric power center.

Production is currently being confined to sintered metal clutch plates for

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37 years' experience in making special bolts, studs, nuts for specific job requirements.
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Steelwright to the Nation
REPRESENTATION IN PRINCIPAL CITIES

Alumibonding

is basically a casting process — the bonding layer being an intermetallic compound of the two joined metals. Pure aluminum and the generally used casting alloys can be bonded by this process to cast iron, carbon and alloy steels, or stainless steel. Heat treatment after bonding is possible

APPLICATIONS

Applications of the ALUMIBONDING process of molecularly bonding aluminum and its alloys to steel or iron may be grouped into four classes:

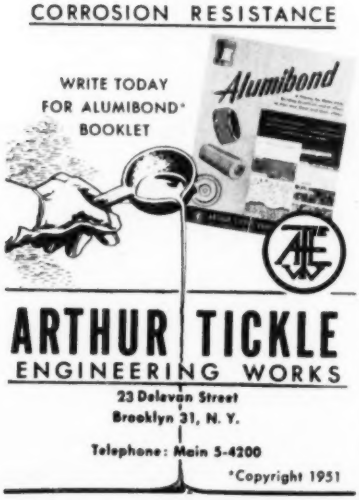
LIGHTWEIGHT

Combining the lightness of aluminum and the strength of steel and taking advantage of the machinability of aluminum.

HEAT DISSIPATION

BEARING PROPERTIES

CORROSION RESISTANCE



ARTHUR TICKLE ENGINEERING WORKS

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tank transmissions to supplement capacity operations at the Raybestos Division, Stratford, Connecticut. The company plans to expand the Wabash Division over a period of years to include the manufacture of other sintered metal products for automotive automatic transmissions, agricultural and industrial equipment, as well as some of its diversified products of asbestos and rubber—brake linings, fan belts, automotive hose, industrial rubber products, mechanical packings, asbestos textiles, abrasive and diamond wheels.

Radio Program to Dramatize Engineer Shortage

A special program dramatizing the nation's critical need for engineers will be featured on "Adventures in Research", the Westinghouse Electric Corporation's radio science show broadcast by over 300 stations in the United States and abroad.

Entitled "Supermen Wanted" the transcribed public-service feature will highlight the role of the engineer in the technological growth of the nation and emphasize the present critical shortage of technical manpower. Estimates indicate that by 1954 the number of engineering graduates will be 40 per cent below the minimum requirements of 30,000 a year.

The program will be broadcast during the week beginning Sunday, November 25.

Improved Alloy

According to a recent research report from the AF an improved technique of forming magnesium alloys has been developed.

The new alloying process consists of mixing atomized magnesium powder with powder of the alloying metals and extruding the powder mixture. In the conventional process magnesium and the alloying metals are melted together, then cast to form alloy ingots or billets which are then extruded.

According to this report, the powder-extrusion process results in many alloys having higher strength than alloys of the same composition prepared by extrusion of billets. Powder extrusion is also said to make possible new

FREE BOOKLET

tells how to speed maintenance

THIS illustrated digest contains a wealth of sound, practical ideas to expedite Diesel maintenance, keep operating costs low and extend equipment life. Gives details on such subjects as:

- Cleaning filters
- Desludging lube oil coolers
- Descaling jacket water coolers
- Degreasing engine parts before repair
- Steam-detergent cleaning
- Plant maintenance cleaning

Manual also discusses tested Oakite procedures for streamlining maintenance in steam control stations and electric power plants.

FREE copy of this 16-page digest yours on request. Consult your local Oakite Technical Service Representative. Or write address below. No obligation.

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MATERIALS • METHODS • SERVICE

alloy compositions not obtainable by the melting and casting process, and these new compositions are said to provide alloys of greater strength, improved corrosion resistance and better fabrication characteristics.

Baldwin-Lima-Hamilton Change

Baldwin-Lima-Hamilton Corporation, Eddystone, Pa., has announced recently that on or about January 1, 1952 the sales, engineering and manufacturing activities of The Whitcomb Locomotive Company, a wholly-owned subsidiary located at Rochelle, Illinois, will be transferred to the Eddystone, Pa. plant.

The contemplated transfer represents a broadening and strengthening of the corporation's position in the field by concentrating all locomotive manufacture in the Eddystone Plant where ample facilities are available. This consolidation of product manufacture is in line with the company's policy of integrating the various components in the company to insure more efficient and economical operation.

The Whitcomb Plant at Rochelle will be utilized to provide much needed space for the expansion of the manufacturing activities of the Austin-Western Company, another subsidiary, whose principal plant at Aurora, Illinois, is taxed to capacity by the demand for road-building and material handling equipment.

Steel Pipe Capacity

The great increase in the use of oil, gas and other pipeline products is reflected in the 43 per cent rise in three years in the capacity for making steel pipe and tubing. The steel industry's facilities for making all kinds of pipe and tubing had an annual capacity of more than 12,500,000 tons at the beginning of 1951, after an annual average increase of 1,200,000 tons of capacity in the three-year period, and further enlargement is under way. Pipelines for oil and gas, according to the American Iron and Steel Institute, measured 450,000 miles, which represented nearly 60,000,000 tons of steel pipe in the ground.

Anti-Freeze Supply in Good Shape

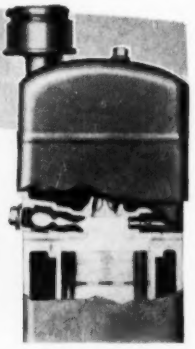
According to a recent statement by the Department of Commerce there will be an adequate supply of anti-freeze this winter. A survey of nine major producers revealed that they have almost 100 million gallons available for use. This is an average of almost two gallons per car in the U. S. While this situation is good, last minute winterization is still not recommended.

Southern Railroad Orders 100 Units

The Southern Railway recently placed orders for an additional 100 diesel-electric locomotive units costing $16,500,000. The new locomotive power is being purchased in order to better handle the increased volume of traffic resulting from the national defense

Designed for top diesel performance

LANOVA COMBUSTION SYSTEM



Look for the distinctive Lanova combustion chamber design in your next diesel — it's a sure guarantee of —

- High combustion efficiencies
- Topnotch operating economy
- Smooth, quiet operation
- Clean exhaust
- Easy starting

You'll find The Lanova System only in diesels manufactured by Lanova licensees. Their names will be furnished on request.

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Specify
COLUMBIA
A. C. and D. C.
GENERATORS

- For Coupled Service
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Columbia, with its years of experience, brings to generator set assemblers a wide line of performance proved, sturdily built, A. C. and D. C. Generators.

AC Generators: 6¼ to 1000 KVA
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Write for information. Our Engineers will be glad to review your requirements.

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TAC does what no other tool can do!
AT LAST! AN OPEN-END RATCHET WRENCH — the world's first true universal wrench. A patented design for connections on tubing, rods, piping, conduit, studs, etc. Sixty-four socket sizes from ⅜" to 4". Smallest effective ratcheting arc yet — 5° to 7½°. TAC will also do every job any ordinary ratchet wrench will do: one TAC set replaces literally dozens of single-purpose hand tools.
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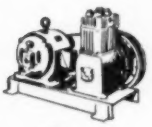
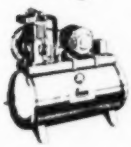
Quincy COMPRESSORS FOR DEPENDABLE COMPRESSED AIR SUPPLY





Modern, compact, rugged Quincy Compressors are designed to serve you faithfully for a long, long time and deliver the compressed air required. Quincy Compressors are available in a wide variety of sizes ranging from 1 to 90 C.F.M. Depend on a Quincy specialist to help you select the type and size compressor to meet your needs. Write Dept. J-22 for details and prices.

ONLY Quincy OFFERS ALL THESE FEATURES

- Timken Bearings
- Lynite Rods
- Perfectly Balanced Crankshaft
- Copper-Finned Intercooler
- Automatic and Positive Lubrication

QUINCY COMPRESSOR CO. QUINCY, ILLINOIS

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program. The delivery of the new diesel units is expected in 1952. Orders were divided among the American Locomotive Company, Electro-Motive Division of General Motors and the Baldwin-Lima-Hamilton Corporation.

Ceramic Coatings for High-Temperature Alloys

Ceramic coatings recently developed by the National Bureau of Standards are substantially increasing the service life of high-temperature alloys. Most successful and widely used of these coatings is NBC ceramic coating A-417, which has been in commercial production since early 1950. The new protective material was developed by William N. Harrison, Dwight G. Moore and associates of the NBS staff, under the sponsorship of the National Advisory Committee for Aeronautics. The coating is applied by spraying or dipping and is then fired for a few minutes at 1850° F.

Ceramic coatings are applied to heat-resistant alloys for protection against such forms of deterioration as scaling and intergranular corrosion. Uncoated alloys suffer mostly from the chemical action of hot corrosive gases —particularly oxygen, lead bromide, sulfur compounds, and hydrocarbons. The erosive effect of the gases impinging on the alloys at high velocity seems also to be a factor in certain types of service.

Because the better heat-resisting alloys contain substantial amounts of scarce alloying elements, the NACA was particularly interested in development of coatings to extend the service life of hot-operating parts made of these alloys.

New Arcos Distributors

Arcos Corporation, manufacturer of stainless low alloy high tensile and non-ferrous electrodes, Philadelphia, announces the appointment of exclusive distributors for the St. Louis and Des Moines territories.

The Clements Welding & Machinery Company will service St. Louis and that part of Missouri and southern Illinois east of Springfield and Sedalia. The R. & R. Welding Supply Company will cover central Iowa, including Cedar Rapids, Mason City, Waterloo and Fort Dodge.

API Award to Gen. Thompson

Lieutenant-General Ernest O. Thompson, one of the nation's foremost petroleum conservation experts, was named the 1951 recipient of the American Petroleum Institute's "Gold Medal for Distinguished Achievement." He received the medal in person in Chicago on November 7, during the course of the Institute's 31st Annual Meeting.

General Thompson is a member of the Texas Railroad Commission, and has been since 1932. The Commission is the regulatory body for the oil industry in Texas, and he has exercised a tremendous influence in the development of conservation policies to protect this nation's reserves of oil. He is also an author and founder of the

Interstate Oil Compact Commission, and has played a leading role in perfecting techniques to increase the amount of oil that could be extracted from the earth.

More Diesels for Canadian Pacific

During the period from September 20 to October 18 the Canadian Pacific Railway received two 1500-hp. diesel-electric freight "A" units, making the total number received three, on an order for four; and two 1500-hp. diesel electric freight "B" units, also making the number received three on an order for four built by the General Motors Diesel, Ltd. at London, Ontario; all four units received in this period are equipped with steam generators.

During the same period orders for other diesel equipment were placed for: six 1500-hp. freight diesel "A" units and ten 1500-hp. freight diesel "B" units, freight and passenger service, all equipped with steam generators, and one 1500-hp. diesel freight "B" unit, and three 1500-hp. diesel road switchers, two with steam generators, all from General Motors Diesel, Ltd.

Other new equipment includes six 1600-hp. freight and passenger diesel "A" units with steam generators and six 1600-hp. freight and passenger "B" units also equipped with steam generators from Fairbanks-Morse; six 1000-hp. diesel switchers and twelve 600-hp. diesel switchers from the Montreal Locomotive Works.

Brown Pyrometer for Diesels

Brown instrument division of Minneapolis-Honeywell Regulator Co. has announced a line of diesel engine pyrometers. Special thermocouple assemblies for use with the pyrometers are available to facilitate installation and service.

In addition, Brown moisture-proof rotary switches for switching the pyrometer indicating instrument to the various thermocouples in the engine can be supplied, either as an integral part of the instrument itself or as a self-contained unit for separate mounting.

New Fuel Additive to Prevent Clogging

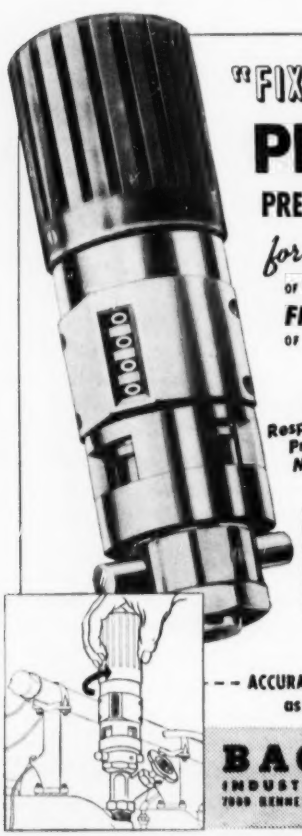
A new fuel additive, which the maker claims will reduce maintenance costs due to clogged filter screens and fouled fuel injector parts, is now being marketed by Shell Chemical Corp.

Known as Ionad 17, the new additive has been under investigation for some time. Tests have shown that it is stable, non-corrosive, and easy to use. Accumulation of tank sludge is also prevented.

Lincoln Electric Moves

Lincoln Electric Company of Cleveland has recently moved all executive and plant offices to a new modern plant in the same city.

The move of the company's machine division involved tons of material and



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PREMAX
PRESSURE INDICATOR
for DIRECT-READING
OF COMPRESSION AND
FIRING PRESSURES
OF EVERY TYPE OF DIESEL ENGINE

ONE OF THE FEATURES
Responsible for Its Overwhelming
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No mistake can be made in reading—since only one figure appears in the window of the counter—and this figure represents the actual engine pressure directly in pounds per square inch.

For other features, write for Bulletin 294

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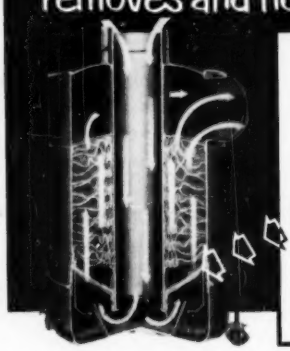
New Tray-Type AIR CLEANER
removes and holds more dirt!



RECOMMENDED FOR HIGH-CAPACITY ENGINES on large tractors, rock crushers, power shovels, etc. Large dirt-holding capacity allows longer interval between servicing.

REMOVABLE TRAY SIMPLIFIES SERVICING. Entire tray is quickly removed for cleaning. Multiple screens prevent clogging of condensing element.

IN THIS NEW Donaldson heavy-duty cleaner, the removable multi-screen "tray" and revised oil cup design feeds more of the condensed oil back into the air stream adjacent to the center tube.

A balanced distribution of oil across the entire lower element has been achieved, eliminating both overloaded and "thin" areas.

Extensive tests in the field over a period of five years prove conclusively that the new cleaner has a higher efficiency and a greater dirt-holding capacity. We invite manufacturers to write or call for design data and test reports.

DONALDSON CO., INC. 666 Pelham Blvd., St. Paul 4, Minnesota
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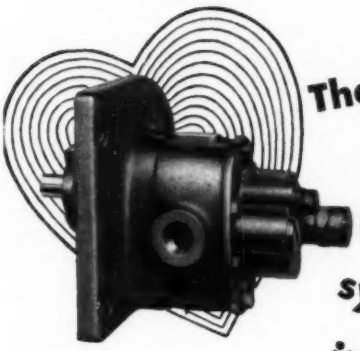
Donaldson AIR CLEANERS



The HEART of a diesel lubricating system is its PUMP

Rotary geared pump with special flange mounting becomes integral part of diesel engine when installed. Note opening above relief valve for tachometer.

Modern diesel operation generally requires a pressure lubricating system — and the vital element is the pump. Thousands of Brown & Sharpe pumps are now providing reliable service month after month without interruption, for lubrication, transfer, or booster systems. Available with various types of flange mountings and special internal construction to meet specific requirements. Write for catalog. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

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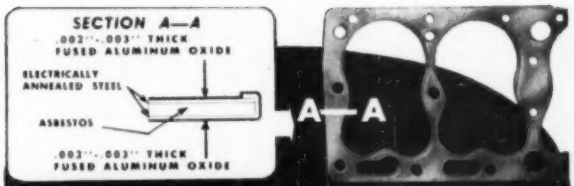

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Fitzgerald Metallic Aluminum-Fused-Oxide Steel Asbestos Gaskets*

Grease Retainers — Cork Gaskets

FITZ-Rite* Treated Fiber Gaskets for oil, gasoline and water connections. Complete Sets For Motor Rebuilders. *S. M. Reg. Pending

FITZGERALD *Gaskets*

SINCE 1906

The Fitzgerald Manufacturing Company

TORRINGTON, CONNECTICUT

There's a Fitzgerald Gasket for every Engine

some 1500 machines. Work has begun on moving out the electrode division which will complete the transfer of all operations into the new plant.

Organizational News

G-E Change

Arthur F. Vinson, formerly manager of employee and community relations of General Electric's small apparatus division, has been appointed assistant manager of the manufacturing services division, with headquarters in Schenectady.

Mr. Vinson joined the corporation as a student engineer and then held successive positions as process engineer, dc. motor section head, and inventory control supervisor. He has been assistant production manager at the Fort Wayne Works and assistant production manager of the apparatus department. In 1943 he became manager of the welding divisions.

Air Filter Appointment

Harry J. Noles has been appointed manager of the air filter division of

the American Air Filter Co., Inc. to succeed the late Howard W. Pound. Mr. Noles, formerly assistant manager of the division, joined the company in 1928 while still a student at the University of Kentucky where he studied mechanical engineering.

American Brake Shoe Executives

William M. Black was appointed president and Joseph L. Mullin vice president of Electro-Alloys Division, American Brake Shoe Company. Walter G. Hoffman, formerly president of the division, was appointed assistant to the vice president for research and development of the corporation.

Mr. Black is a vice president of the corporation and also president of the American Manganese Steel Division of the company. He joined the firm as an apprentice in 1912 and served in both operating and sales departments prior to becoming president of the Amsco Division in 1940.

Mr. Mullin is vice president in charge of operation for American Manganese Steel Division and will continue in that capacity. He joined the company in 1914 and has since been continuously associated with the production of manganese steel.

Mr. Hoffman will be assigned to special metallurgical development projects at the company's research center in Mahwah, New Jersey. He started with the sales department of American Manganese Steel Division in 1930, and became president of Electro-Alloys Division in 1943.

HILCO LUBE AND FUEL OIL PURIFICATION FOR DIESEL AND GAS ENGINES . . .

PURIFIERS · FILTERS · RECLAIMERS · CONDITIONERS

THERE'S A HILCO FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM . . .

YOU WANT CLEAN OIL AND CLEAN ENGINES TO SAVE EQUIPMENT - OIL AND MONEY - INVESTIGATE HILCO OIL MAINTENANCE METHODS

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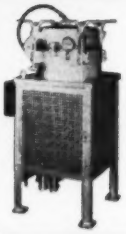

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Sterling Engine Elects

Three officers of Graham Paige Corporation have been elected to high posts in Sterling Engine Company, following purchase of 32 per cent of the prior preferred stock of the Sterling Engine Company.

Joseph W. Frazer has been elected chairman; John J. Bergen, chairman of the executive committee; and Irving Mitchell Felt, chairman of the finance committee.

Waukesha Elects

The board of directors of the Waukesha Motor Company recently announced the election of Charles E. Nelson, Jr. as a director of the company.

Mr. Nelson, also vice-president, production, entered the organization in 1929 following several years as state wholesale representative for a major motor car manufacturer. His earliest activities with the company were connected with the financial department and led to his appointment in 1933 as secretary and treasurer of the Fagoel Truck and Motor Coach Company of Oakland, California, at that time a

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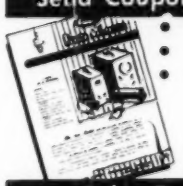

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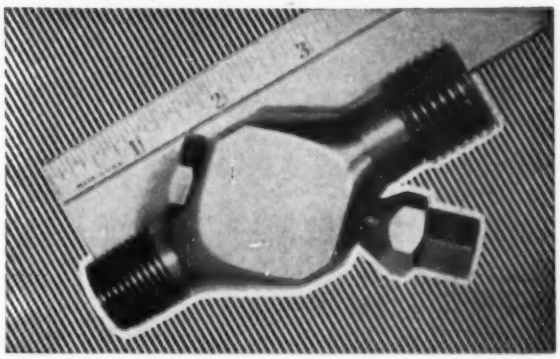

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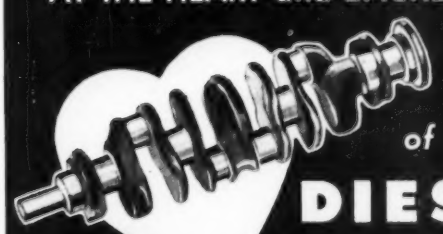

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Diesel Power and Diesel Transportation

subsidiary of the corporation. Returning to Waukesha in 1934, he became factory production manager and in 1936 was made director of purchases and production planning. In 1947 he was appointed assistant to the president, and in 1949 vice president in charge of production.

Mr. Nelson is active on the executive committee of the Internal Combustion Engine Institute and on the Munitions Board and National Production Authority committees on internal combustion engines. For a number of years he served on the National Committee on Economic Development.

John Reiner Appoints

Herman B. Robbins has been named as sales manager of the generator set division of John Reiner & Company. This division handles the distribution and sales of D. W. Onan generator sets as well as the company's line of diesel and gasoline generator sets, marine auxiliaries and oil field utility units.

In addition to his regular duties Mr. Robbins will also be in charge of all the export activities of the company.

Cummins Change

R. F. Davis, former assistant regional manager, central region with headquarters at Chicago, has been promoted to regional manager, eastern region, of the Cummins Engine Company, Inc.

Mr. Davis has been employed by the company since 1942. He first served as an inspector on the production line, and in 1944 was transferred to the purchasing department, where he became field expediter. In 1947 he became manager, engine sales, and held this post until November, 1948, when he joined the regional organization.

Baldwin-Lima-Hamilton Reorganization

The Baldwin-Lima-Hamilton Corporation announced recently that a new assignment of responsibility has been made in the operating management of its Eddystone plant.

John S. Newton, vice president, will have complete responsibility for the Locomotive Division; Raymond B. Crean, vice president, for the Southwark Division; and James R. Weaver, vice president, will have complete responsibility for the newly created Defense and Special Products Division.

Nordberg Appointment

Appointment of James H. Burtis as sales engineer, 4-cycle engine department, was recently announced by the Nordberg Manufacturing Company.

Mr. Burtis, a graduate of Columbia University, has been employed by Consolidated Edison, New York Central Railroad and Jackson & Moreland. He served in the Panama Canal zone for the latter company for two years. In

1942 he joined the Rural Electrification Administration as a plant engineer with a territory covering 22 Atlantic and Gulf Coast states. He has also served as a sales engineer with Fairbanks, Morse and with the U. S. Army Corps of Engineers before joining Nordberg.

American Locomotive Changes

New appointments in American Locomotive Company's sales, service and renewal parts department were announced recently.

Paul N. Strobell, formerly eastern districts manager for Alco-GE locomotive sales and field service, was appointed assistant to vice president of eastern regional sales, with headquarters at New York City. Ralph M. Darrin, Jr. succeeded Mr. Strobell with headquarters at Schenectady. Frederick Townsend was appointed assistant manager, Alco-GE locomotive sales and field service for field service at Schenectady. Richard B. Fairman was named regional renewal parts manager, eastern section, northeast regional renewal parts office, located at Schenectady.

Canadian Locomotive Vice President

J. F. Weiffenbach has been appointed vice president in charge of

manufacturing of Fairbanks, Morse & Company's affiliate, the Canadian Locomotive Company. He succeeds J. J. Jarrell, who has retired following 45 years with the firm.

Mr. Weiffenbach was associated for 12 years with the Electro-Motive Division of General Motors, serving several years as locomotive engineer. Five years ago he joined Fairbanks, Morse

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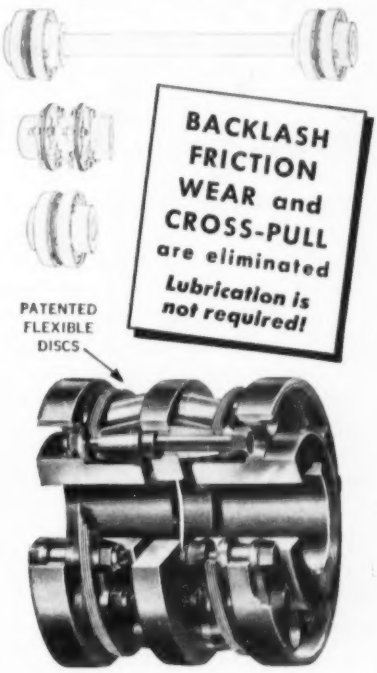

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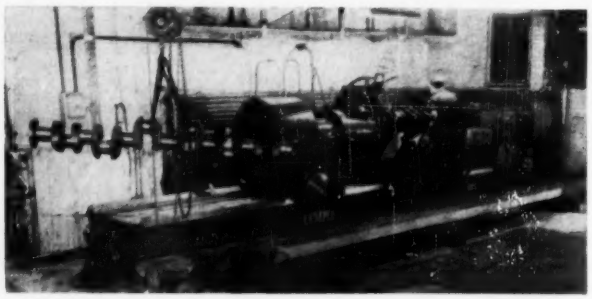

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& Company in Chicago. He subsequently was appointed chief engineer of the company's diesel locomotive division, and later manager of engineering at the Beloit plant. He became works manager of the Canadian Locomotive Company plant at Kingston in April, 1951.

In his new post, he will direct the manufacture of diesel-electric locomotives and engines as well as a wide range of industrial equipment.

Minneapolis-Honeywell Manager

William H. Sisson has been named power industry manager for Minneapolis-Honeywell Regulator Company, it was recently announced.

Mr. Sisson, formerly manager of the Indianapolis office, will promote product sales in the central station and power fields. His new headquarters are at Philadelphia.

General Metals Executive Named President, California Manufacturers Association

William A. DeRidder was elected president of the California Manufacturers' Association at a recently held meeting of the board of directors. He

is chairman of the board of General Metals Corporation, of which Enterprise Engine and Machinery Co. is a subsidiary.

Mr. DeRidder has been with Western Drop Forge Company, and when this firm was incorporated into General Metals he was appointed vice president of the new corporation. He held this position seven years, when he was elected president.

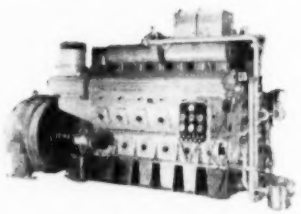
Lever Diesel

(*Concluded from page 67*)

figures are anticipated upon further refinement of the combustion chamber to show improved performance.

Torsional vibration in this design and construction is minor, although in some installations a damper might be considered advisable. Rugged construction of the reciprocating assembly is required due to the multiplication of forces in a lever system. The connecting rod, for example, bears a 50 per cent greater load than the piston rod pin and is therefore designed accordingly. Except for the fulcrum, these pins are under full pressure lubrication. Both pins along with the pistons and rods for each cylinder are readily removable through the side of the engine block. Overall dimensions of the engine indicate that it is a few inches higher than the conventional type of engine.

As the engine is still in the testing stage, further development should be interesting to watch. It is reasonable to expect that future refinements will show improved performance.



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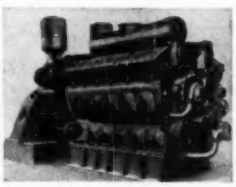

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Fredonia, Kansas Plant

(*Continued from page* 61)

to be clean and in perfect condition. In the continuous purifier, it has been necessary to change filtration elements only every three months, which represent more than 2000 hrs. operation.

In the year cited the duafuel engine used 1922 gal. of lubricating oil for an average of 5442 hp. hr. per gal. Actually the performance was considerably better. The gallonage recorded is the quantity fed through the cylinder lubricators which is greater than actual consumption. Approximately one-third of the oil has to be drained off from the crankcase supply. Allowing for this reclamation, the engine is running better than 6000 hp. hr. per gal. of lubricating oil consumed.

The new engine was tied into the plant cooling water system which employs motor-driven centrifugal pumps and a spray pond. Though the system is open, treated city water is used for makeup and there has been no trouble with scaling. In the Nordberg duafuel engine lubricating oil is used to cool the pistons and in turn is circulated through an oil cooler. There are alarms on pressure and temperature of lube and jacket water.

Air for the duafuel unit comes through an oil-bath filter to the exhaust-driven turbocharger which supplies the cylinders with fresh air under pressure. The exhaust gases, after leaving the turbocharger, vent through a vertical silencer.

The plant is well staffed with four operators, a chief operator and two oilers, all under the supervision of the superintendent of utilities.

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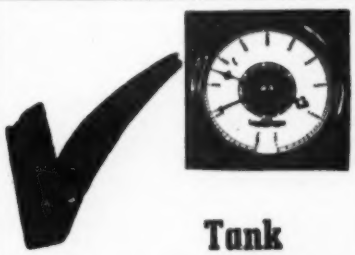

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Zallea Expansion Joint News

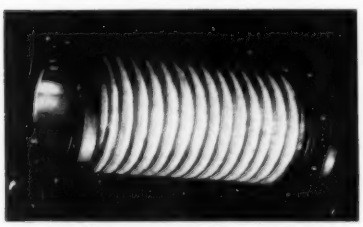
PUBLISHED BY ZALLEA BROTHERS—WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

Expansion Joint of the Month

Why Zallea Joints Last Longer

FLEXIBLE CONNECTORS

The Zallea Stainless Steel Flexible Connector has met a widespread need for an inexpensive type of expansion joint capable of absorbing both axial and lateral movement at low pressures. Ideal applications include Diesel engine exhausts, high temperature air, gas engine exhaust lines, aircraft thermal de-icing and heating systems. They are extremely flexible and long-lasting because of their design, having a true bellows form. Like all other Zallea Expansion Joints, they are hydraulically formed and have a uniform wall thickness. All corrugations are annular and parallel, with the axis perpendicular to the centerline of the connector. This construction is much



more flexible than the spiral or helical form of corrugation found in "metal hose" heretofore used on some of these applications. Zallea Flexible Connectors are formed from tubes having a single longitudinal weld, whereas the type commonly called "seamless" has a spiral weld running around the crest of every other corrugation. This spiral corrugation exerts a torque on the adjacent connections when compressed. Available in diameters from 4" to 72" with flanged or welding ends or a combination of both. Made of stainless steel to handle exhaust temperatures in excess of 750° F.

. . . a complete, practical catalog on all Zallea Expansion Joints. A text book and a valuable reference source. Send for your *free* copy *today!*

ZALLEA BROTHERS, 812 Locust Street
Wilmington 99, Delaware.

CONTROLLED WELDING ASSURES LONGER EXPANSION JOINT LIFE

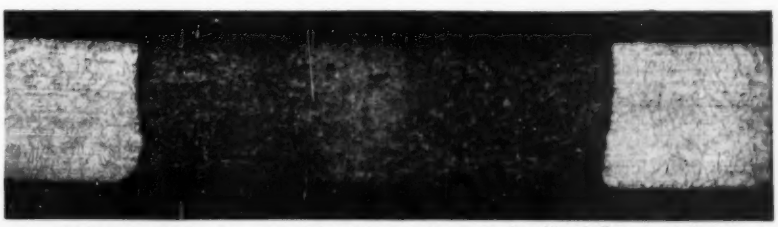
In a corrugated expansion joint, the deflection stress varies directly as the bellows thickness. And, the life of a corrugated expansion joint varies as the cube of the bellows thickness. Therefore it is essential that the corrugated bellows have a uniform thickness throughout. Only in Zallea Stainless Steel Expansion Joints are you assured of this optimum condition because Zallea alone produces a longitudinal weld of the same thickness as the parent metal.

Welding Methods Tested

Accelerated flexing tests of corrugated bellows proved that the resultant welding bead of a shielded arc weld was detrimental to the life of the bellows because failure always occurred across the weld —thickest section of the bellows. Zallea metallurgists, after analyzing the many known welding processes, found that by adopting an exclusive variation of the Heliarc process and adding a grain refining procedure to the finished weld, they could produce a corrugated bellows that under accelerated flexing tests *failed in the parent metal only.*

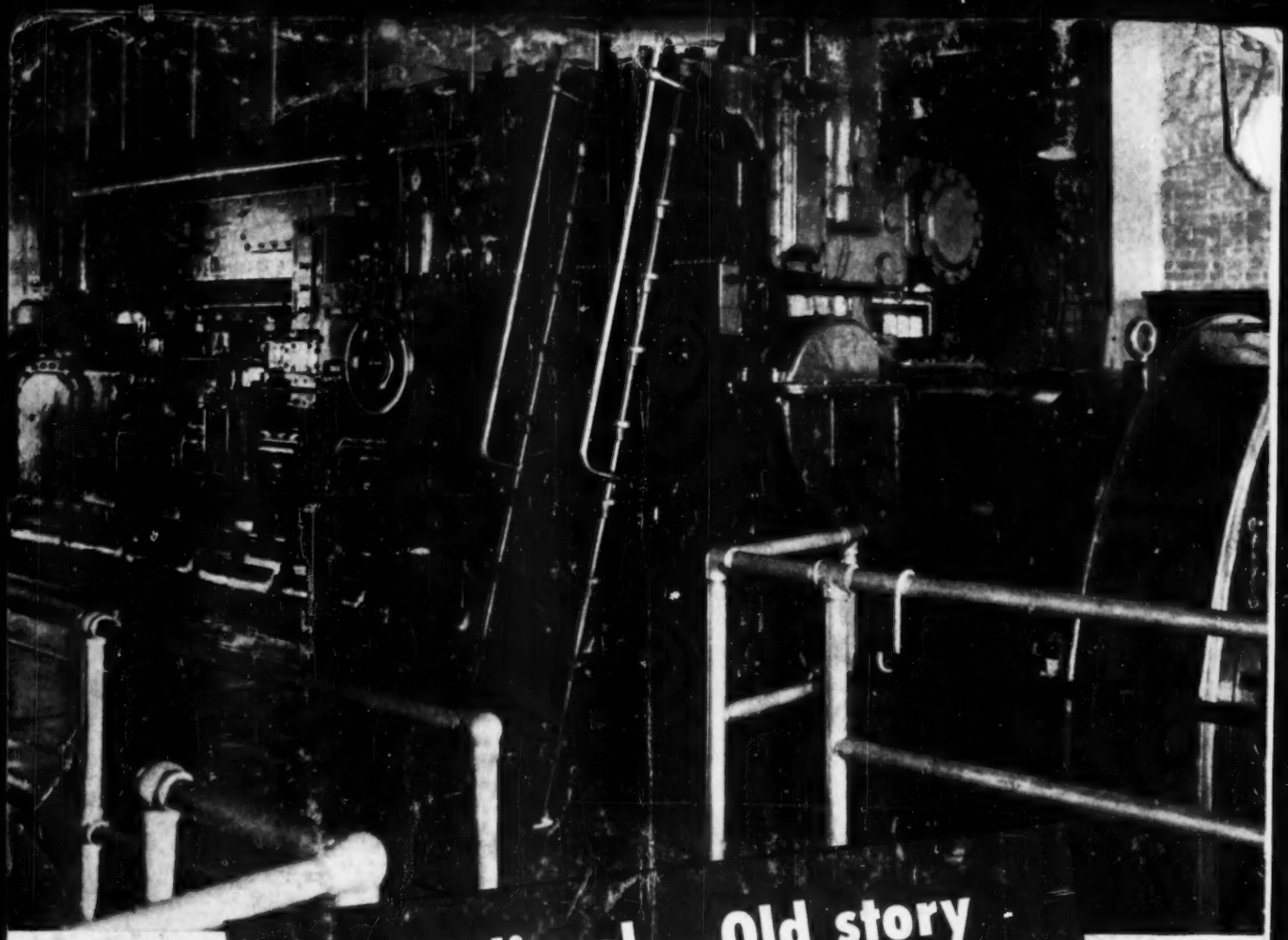
Longer Life Assured

In over 100 bellows tested with Zallea *controlled* welding, not one failure occurred within 30 degrees of the weld line. More important was the fact that these bellows lasted four to eight times longer than bellows having a shielded arc welding bead. The two unretouched photomacrographs below illustrate the exclusive Zallea *controlled* welding technique as compared to the welding procedure used in other expansion joints. When you want the best in stainless steel expansion joints, always specify ZALLEA . . .you'll find it pays!



Weld bead of Zallea Expansion Joint: *(Compare fine grain of weld with illustration below)*

Weld bead of competitive expansion joint



New diesel...Old story

• When the city of Garnett, Kansas, placed this 1,400-HP diesel in service in the municipal power plant early in 1948, STANDARD HD Oil was the logical choice for a lubricant. The superior performance of Standard fuels and lubricants was already an old story to operators at Garnett, since they had been used for over 20 years in the plant's other generating equipment. One diesel, for example, has logged over 70,000 hours and is still running with the original pistons. A set of rings consistently delivers over 20,000 engine hours.

Since installation of the new equipment, lubrication has been trouble-free and exceptionally economical with consumption averaging better than 9,000 HP-hours per gallon of lubricant consumed.

A Standard Oil lubrication specialist can help put STANDARD HD Oil to work to your advantage in your own diesels. For his services, call the Standard Oil Company office in your own area, or write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

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